27. INORGANIC GEOCHEMISTRY OF SEDIMENTS AND ROCKS RECOVERED FROM THE SOUTHERN ANGOLA BASIN AND ADJACENT WALVIS RIDGE, SITES 530 AND 532, DEEP SEA DRILLING PROJECT LEG 75[1]

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ABSTRACT

Samples of sediments and rocks collected at DSDP Sites 530 and 532 were analyzed for 44 major, minor, and trace elements for the following purposes: (1) to document the downhole variability in geochemistry within and between lithologic units; (2) to document trace-element enrichment, if any, in Cretaceous organic-carbon-rich black shales at Site 530; (3) to document trace-element enrichment, if any, in Neogene organic-carbon-rich sediments at Site 532; (4) to document trace-element enrichment, if any, in red claystone above basalt basement at Site 530 that might be attributed to hydrothermal activity or weathering of basalt. Results of the geochemical analyses showed that there are no significant enrichments of elements in the organic-carbon-rich sediments at Site 532, but a number of elements, notably Cd, Co, Cr, Cu, Mo, Ni, Pb, V, and Zn, are enriched in the Cretaceous black shales. These elements have different concentration gradients within the black-shale section, however, which suggests that there was differential mobility of trace elements during diagenesis of interbedded more-oxidized and less-oxidized sediments. There is little or no enrichment of elements from hydrothermal activity in the red claystone immediately overlying basalt basement at Site 530, but slight enrichments of several elements in the lowest meter of sediment may be related to subsea weathering of basalt.

INTRODUCTION

Three hundred forty-eight samples were collected for inorganic geochemical analyses at Deep Sea Drilling Project (DSDP) Sites 530 (Holes 530A and 530B) and 532 (Holes 532 and 532B) (Fig. 1). The samples were collected with the following purposes in mind:

1) At least one sample was collected from each 9.5-m core, whenever possible, to document the general geochemical variability between and within lithologic units at each of the two sites;

2) Sixty-seven samples of red and green claystone and of black shale were collected from lithologic Unit 8 in Hole 530A in order to examine geochemical differences among these three distinctly colored lithologies that might provide clues as to the mechanism of enrichment of certain trace elements in black shales;

3) Eleven samples of red claystone in an interval of 180 cm above basalt basement in Hole 530A were collected to determine if there was enrichment in any elements that might be attributed to hydrothermal activity or weathering of basalt;

4) Thirty-two samples of light-colored sediment and 27 samples of dark-colored sediment were collected from color cycles in Holes 532 and 532B to determine if there were any geochemical differences that might be used to determine the origin of these cycles.

METHODS

The 348 samples were air-dried and ground to pass a 100-mesh (149 μm) sieve. Thirty-one of the 348 samples were chosen at random for duplicate analyses; all 379 analytical samples (348 samples plus 31 duplicates) were submitted to the analytical laboratories of the U.S. Geological Survey. The samples were analyzed for 10 major and minor elements by X-ray fluorescence spectrometry (XRF; Taggart et al., 1980), and 44 major, minor, and trace elements by induction-coupled, argon-plasma emission spectrometry (ICP; Floyd et al., 1980). Six elements (Al, Fe, Mg, Ca, Na, and Ti) were analyzed by both XRF and ICP. Means and standard deviations for analyses of these six elements by both methods are given in Table 1. The following elements (and their lower detection limits in parts per million) were looked for by ICP but not detected: Ag (20), Au (20), Bi (100), W (50), Ta (50), Pr (50), Sm (30), Eu (10), Gd (10), Tb (100), Ho (10), and Er (10).

Because the samples were air dried, the analytical results for sodium include some sodium that was present in interstitial seawater. Concentrations of Na in samples from hydraulic piston cores (HPC) in Holes 530B, 532, and 532B were corrected for interstitial seawater-Na by using measured water contents and wet-bulk densities (see Physical Properties sections of the site summeries, this volume) and assuming that this interstitial water was normal seawater with a sodium-ion concentration of 10.566 mg/ml. We felt confident in applying this correction to the HPC samples because they are less than 6 m.y. old and have undergone little diagenesis and compaction. We did not feel confident, however, in applying this correction to the rotary-core samples (Hole 530A) because of the highly variable lithology and degree of diagenesis. The maximum interstitial-seawater-sodium in the HPC samples was about 30% of the total sodium. The sodium results for Hole 530A in Table 2 should therefore be used with caution because they contain variable proportions of interstitial seawater-Na.

Results of analyses for Holes 530A, 530B, and 532 plus 532B are given in Tables 2, 3, 4A and 4B respectively, and plotted versus depth in Figures 2, 3, and 4 respectively.

RESULTS

Site 530

Hole 530A was rotary drilled from 125 to 1103 m sub-bottom, ending in 4 cm of highly altered basalt. The top 180 m of sediment at Site 530 was recovered by HPC in Hole 530B.

The contact between altered basalt and the oldest sedimentary unit at Site 530, lithologic Unit 8 (Fig. 2), contains a system of dendritic veinlets of calcite that extend about 5 cm into red claystone of Unit 8 (Site 530, this volume). A 180-cm interval of red claystone immediate-

[1] Hay, W. W., Sibuet, J.-C., et al., *Init. Repts. DSDP,* 75: Washington (U.S. Govt. Printing Office).

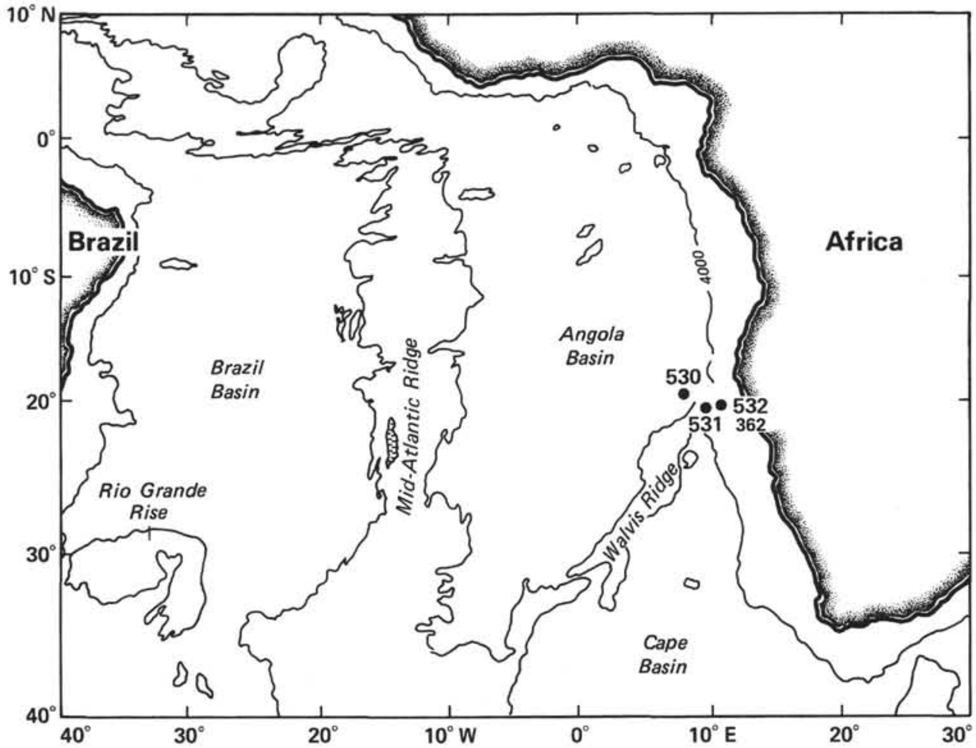


Figure 1. General bathymetry of Walvis Ridge and southern Angola Basin off southwestern Africa, and locations of DSDP Sites 362, 530, and 532.

Table 1. Means and standard deviations of concentrations of Al, Fe, Mg, Ca, Na, and Ti in 379 samples from DSDP Sites 530 and 532 determined by both X-ray fluorescence (XRF) and induction-coupled plasma spectrometry (ICP). (All values are in weight percent.)

Element	Mean (ICP)	S.D. (ICP)	Mean (XRF)	S.D. (XRF)
Al	5.37	2.20	5.03	1.95
Fe	4.13	2.12	4.05	1.97
Mg	1.54	0.75	1.51	0.68
Ca	11.5	10.7	11.1	10.1
Na	1.19	1.72	0.88	1.28
Ti	0.51	0.42	0.50	0.42

ly overlying basalt was sampled at intervals of about 20 cm to determine if the claystone had been enriched in any elements by hydrothermal solutions or from alteration of the basalt. Results of these analyses are discussed in a later section.

Unit 8 consists of 163 m of interbedded red and green claystone and black shale. Individual beds range in thickness from less than 1 cm to several decimeters. Black shale beds comprise about half of the section in Cores 97 and 98 but are minor throughout the rest of the unit (Site 530, this volume). Figure 2 shows that concentrations of most elements are relatively high in Unit 8. Some elements, especially Si, Al, K, B, Sc, Zr, Y, and La, are mostly associated with clay minerals, and their concentrations are high because the clay has not been diluted with $CaCO_3$. Concentrations of these elements also are high in lithologic Unit 3, which also is clay rich and contains even less $CaCO_3$. Most of the other elements that have high concentrations in Unit 8, especially Co, Cr, Cu, Mo, Ni, Pb, V, and Zn, are concentrated in the black-shale beds relative to the green and red claystone beds (see discussion in a later section and Dean, Arthur, and Stow, this volume). Three other elements, Ba, Fe, and Mn, probably are concentrated in Unit 8 because of unusual diagenetic redox conditions within a sequence of interbedded reduced and oxidized sediments.

Lithologic Unit 7 consists of 109 m of red claystone with interbeds of green, red, and purple siltstone and claystone in numerous repeated turbidite sequences (Stow and Dean, and Stow and Miller, this volume). The red claystone of Unit 7 is similar to red claystone that is the dominant lithology of Unit 8 but contains more carbonate, more turbidite sand, and no black shale beds. Concentrations of most elements in Unit 7 are relative low because of dilution by carbonate and coarse-clastic material and lack of black shale. This is emphasized for many elements in Figure 2 because Unit 7 is between two lithologic units with high concentrations of many elements (for example, see plots for Cr and Cu in Fig. 2).

Lithologic Unit 6 consists of a 41-m sequence of thick, carbonate-cemented, volcanogenic, sandstone turbidites. These coarse turbidites are upper-fan channel sandstones that are the culmination of a coarsening-upward deep-sea fan sequence which began with fine-grained, distal mud turbidites of Unit 8 (Stow and Dean, this volume). The volcanic rock fragments in these turbidites contain particularly high concentrations of Al, Fe, Mg, Na, Ti, P, Co, Cu, Cr, Zr, and Sc (Fig. 2). Summary statistics for 9 samples of sandstone from Unit 6 are given in Table 5.

Lithologic Units 4 and 5 are highly heterogeneous and consist of interbedded mudstone, marlstone, sandstone, and clastic limestone, mostly deposited by turbidity currents in fan lobes and channels (see Stow, this volume). The highly variable lithologies of these units are indicated by the extreme variation in concentrations of major elements and many trace elements (Fig. 2).

The Cretaceous/Tertiary boundary occurs near the base of Unit 4 in Core 50, Section 2 at about 592.5 m. The paleontologic boundary was chosen at 592.2 m subbottom and the paleomagnetic boundary was chosen at about 592.6 m (Site 530, this volume). Most of the Upper Cretaceous-lower Tertiary section at Site 530 consists of interbedded red and green claystones and marlstones with occasional limestone beds. One limestone at 592.28 to 592.38 m contains high concentrations of many elements on a carbonate-free basis (Dean et al., this volume). Some elements (e.g., Mg, Mn, Sr, and B) probably are derived mostly from carbonate minerals, but other elements (e.g., V, Zr, Zn, Sc, Co, Pb, Er, Nd, Sm, and Y) probably are not carbonate-related. There is a slight iridium anomaly between about 592.4 and 592.5 m in red claystone just below the limestone bed (Dean et al., this volume).

Lithologic Unit 3 consists of 190 m of red and green muds that differ little in composition, in marked contrast to the inhomogeneous lithologies of underlying Units 4 and 5. Most of the unit contains no carbonate minerals. The compositional homogeneity and lack of diluting carbonate minerals is indicated in Figure 2 by the small amount of variation in concentrations of most major and trace elements. Concentrations of some elements, however, particularly Fe, K, B, Cr, Li, Sc, Zr, Y, and La, are relatively high and variable within Unit 3, and this undoubtedly reflects variations in amount and/or composition of clay.

Units 1 and 2 consist of debris-flow deposits interbedded with background pelagic sediment that contains varying mixtures of siliceous biogenic debris, calcareous biogenic debris, and nonbiogenic material (mostly clay; Fig. 3). Geochemical differences between Unit 2 and Unit 1, and within Unit 1, result primarily from variations in relative proportions of these three sediment components (Fig. 3); Subunit 1a and Unit 2 contain more-or-less equal mixtures of all three components, whereas Subunit 1b contains abundant siliceous biogenic debris (mostly diatoms). Element associations for each of the three sediment components are discussed below for the same components at Site 532.

Site 532

The three lithologic Subunits, 1a, 1b, and 1c, recovered at Site 532 on Walvis Ridge are approximately equivalent to lithologic Units 1a, 1b, and 2, respectively, from Site 530, and, like the Site 530 units, differ mainly in the relative proportions of the same three sediment components, namely siliceous biogenic debris, calcareous biogenic debris, and nonbiogenic material (Fig. 4). The most noticeable characteristic of the entire sediment section recovered at Site 532 is cyclic dark and light color variations (Site 532 and Gardner et al., both this volume). The organic geochemistry of these cycles is discussed by Meyers, Brassell, and Huc (this volume). Inorganic geochemical similarities and differences between light and dark parts of these cycles are discussed in a later section.

The peaks in amount of siliceous biogenic debris at both sites occur in the upper Pliocene to lower Pleistocene parts of the section and apparently correspond to the most intense period of upwelling associated with the development of the Benguela Current system (Gardner et al., this volume). The fact that concentrations of SiO_2 at both Site 530 and 532 show maxima that correspond to maxima in the curves for siliceous biogenic debris obtained independently from smear-slide estimates suggests that much of the SiO_2 is biogenic. For both sites we fractionated total SiO_2 into biogenic SiO_2 and nonbiogenic SiO_2 by using the SiO_2: Al_2O_3 ratio. The plot of SiO_2: Al_2O_3 in Figure 4 shows that there is a baseline low value of about 3.3 in those parts of the section at 532 that do not contain any detectable biogenic SiO_2 in smear slides. We therefore assumed that a value of 3.3 was indicative of nonbiogenic aluminosilicate minerals that were deposited at both sites. Nonbiogenic SiO_2 was then calculated according to the equation:

$$\text{Nonbiogenic } SiO_2 = (\%\ Al_2O_3) \times 3.3.$$

Biogenic SiO was calculated according to the equation:

$$\text{Biogenic } SiO_2 = (\text{total } SiO_2) - (\text{nonbiogenic } SiO_2).$$

Downhole plots of biogenic and nonbiogenic SiO_2 calculated for Hole 530B and Holes 532 and 532B are shown in Figures 5 and 6 respectively. The calculated curves for biogenic SiO_2 show the same trends as the curves for siliceous biogenic debris from smear-slide estimates. However, we feel that the values calculated from SiO_2 and Al_2O_3 analyses are more realistic measures, particularly of weight percent biogenic silica, because smear-slide data are volume estimates that are semiquantitative at best and usually tend to overestimate percentages of siliceous biogenic fragments which are large and porous.

We ran a Q-mode factor analysis of the element-concentration data for Site 532, including biogenic and nonbiogenic SiO_2, in order to see if there were groups of samples based on geochemistry that corresponded with variations in the relative proportions of the three main sediment components. The computer program used for the analysis was a modified version of the CABFAC program described by Klovan ad Miesch (1976). The results of this analysis showed that most elements were associated with the nonbiogenic fraction. This association was particularly evident for Fe, K, Ti, Cr, Cu, V, Zn, Li, Ni, Na, B, Sc, and Y in order of decreasing degee of association with the nonbiogenic fraction. The association of elements with the clastic fraction is illustrated in Figure 4 by the maxima for concentrations of many elements between about 100 and 140 m, which corresponds

Table 2. Chemical analyses of samples from Leg 75, Hole 530A.

Sample	Core	Section	Interval	DEPTH m	% SiO2	% Al2O3	% Fe2O3	% MgO	% CaO	% Na2O	% K2O	% TiO2	% P2O5	% MnO	ppm As	ppm B	ppm Ba	ppm Be	ppm Cd	ppm Co
10011095	1	1	95	125.95	30.0	6.4	3.55	1.65	26.80	1.74	.96	.29	.10	<.02	<20	160	650	<3	<5	8
10023029	2	3	29	137.79	35.9	7.9	3.99	1.89	21.50	2.09	1.47	.38	.11	<.02	<20	80	600	<3	<5	9
10045095	4	5	95	160.45	28.3	8.2	3.68	1.99	27.90	1.38	1.15	.34	.11	.03	<20	180	610	<3	36	10
10046003	4	6	3	161.03	47.9	13.4	5.80	3.01	8.84	2.05	2.92	.65	.15	.02	<20	290	830	<3	21	19
10046004	4	6	3	161.03	47.3	13.3	5.76	2.97	9.12	2.04	2.93	.65	.15	.02	<20	140	710	3	<5	11
10055023	5	5	23	169.23	50.2	11.8	7.78	2.37	6.32	2.00	2.39	.59	.20	.03	<20	150	630	<3	11	11
10062090	6	2	90	174.90	35.3	10.0	4.40	2.49	20.90	1.49	1.89	.43	.08	<.02	<20	120	490	<3	<5	11
10062132	6	2	132	175.32	53.9	13.6	5.91	2.61	3.86	2.25	2.74	.71	.19	<.02	50	150	630	<3	9	27
10072002	7	2	2	183.52	63.7	13.4	5.41	1.64	2.35	3.07	2.48	.70	.19	.02	<20	250	890	<3	13	12
10074116	7	4	116	187.66	18.2	5.5	2.32	1.46	36.70	.88	.52	.22	.11	<.02	60	70	320	3	<5	14
10074117	7	4	116	187.66	18.2	5.5	2.30	1.42	36.90	.92	.59	.23	.10	<.02	<20	120	330	<3	<5	7
10074145	7	4	145	187.95	12.5	3.7	2.14	1.09	42.10	.83	.40	.14	.11	<.02	<20	100	270	<3	<5	6
10084038	8	4	38	196.38	29.7	8.4	4.28	2.20	25.90	1.50	1.23	.37	.10	.03	<20	110	420	<3	10	20
10085028	8	5	28	197.78	52.3	12.9	6.65	3.01	4.24	2.13	2.65	.64	.14	.03	<20	140	540	<3	5	6
10091105	9	1	105	202.05	43.2	11.2	5.05	2.60	14.10	1.93	2.19	.50	.16	.03	<20	130	480	<3	11	9
10103015	10	3	15	213.65	25.3	7.2	3.09	1.79	31.10	1.20	.82	.28	.10	.03	<20	60	360	<3	<5	7
10106007	10	6	7	218.07	54.1	14.7	7.37	3.21	2.28	2.19	3.02	.75	.18	.03	<20	310	630	<3	18	13
10112080	11	2	80	222.30	14.4	4.3	2.00	1.12	40.40	.94	.49	.15	.12	.04	<20	60	340	<3	<5	<5
10112121	11	2	121	222.71	58.2	14.4	5.76	2.43	3.29	2.40	2.93	.78	.17	.02	<20	80	410	<3	<5	8
10124035	12	4	35	234.35	33.4	9.6	4.20	2.31	23.00	1.54	1.62	.42	.11	.03	20	110	450	<3	<5	11
10125005	12	5	5	235.55	55.0	15.4	7.14	3.34	1.87	2.23	3.30	.79	.19	.03	<20	160	430	<3	<5	12
10125006	12	5	5	235.55	54.6	15.3	7.01	3.35	1.85	2.15	3.27	.77	.18	.03	30	160	420	<3	<5	12
10131079	13	1	79	239.79	25.6	7.1	3.03	1.87	30.70	1.18	.88	.32	.10	.03	<20	80	410	<3	<5	<5
10131093	13	1	93	239.93	47.2	12.7	5.54	2.71	11.20	2.05	2.60	.66	.17	.03	<20	100	390	<3	<5	14
10131102	13	1	102	240.02	55.5	11.9	8.15	1.69	6.16	2.56	2.15	.79	.18	.03	<20	250	420	<3	8	12
10143066	14	3	66	252.16	15.9	4.6	2.04	1.32	39.50	.84	.43	.17	.07	.03	<20	50	380	<3	<5	5
10155087	15	5	82	264.82	54.4	15.0	6.89	3.18	3.76	2.03	3.39	.72	.12	.03	<20	160	650	<3	<5	23
10155096	15	5	96	264.96	21.8	6.4	3.13	1.60	33.90	.96	.98	.27	.12	.03	20	50	440	<3	9	<5
10182055	18	2	55	288.55	55.6	16.4	8.03	3.44	1.38	2.10	3.62	.80	.15	.12	<20	180	570	<3	<5	26
10185047	18	5	47	292.97	55.6	16.3	8.28	3.00	1.69	1.74	3.80	.78	.10	.07	<20	290	480	<3	<5	21
10193100	19	3	100	300.00	55.8	16.7	8.04	3.16	1.01	1.84	3.75	.80	.10	.05	<20	200	470	<3	14	29
10203063	20	3	63	309.13	54.2	16.8	9.11	3.40	.51	2.02	3.76	.82	.13	.06	<20	180	400	<3	9	23
10213120	21	3	120	319.20	55.3	16.5	8.82	3.39	.57	1.90	3.88	.81	.13	.09	<20	200	410	<3	17	31
10215129	21	5	129	322.29	55.4	16.6	8.37	3.25	.76	1.96	3.81	.79	.14	.21	<20	170	390	<3	<5	23
10221130	22	1	130	325.80	56.9	16.2	7.95	3.31	.66	1.90	3.73	.75	.11	.06	<20	160	360	<3	7	18
10225130	22	5	130	331.80	55.3	16.2	9.62	3.27	.45	1.79	3.91	.76	.13	.07	<20	160	420	3	<5	19
10241111	24	1	111	344.61	53.9	15.8	8.81	3.34	1.57	2.04	3.13	.82	.18	.16	30	140	290	3	<5	33
10241143	24	1	143	344.93	6.1	2.0	1.00	.79	48.70	.42	.12	.06	.08	.79	<20	40	40	<3	<5	<5
10246077	24	6	77	351.77	58.8	15.5	7.82	3.31	.70	2.24	3.02	.81	.14	.06	<20	120	450	<3	<5	20
10254085	25	4	85	358.35	57.6	14.9	8.72	3.35	.65	2.21	2.95	.77	.13	.06	<20	320	420	<3	21	26
10262138	26	2	138	365.38	58.6	15.1	8.04	3.25	.54	2.19	3.14	.75	.12	.04	<20	120	450	<3	<5	14
10262139	26	2	138	365.38	58.6	15.1	8.03	3.28	.55	2.15	3.17	.75	.11	.04	<20	100	430	<3	6	10
10273098	27	3	98	375.98	58.1	15.3	7.89	3.19	1.07	2.03	3.32	.78	.16	.05	20	340	690	4	25	26
10283030	28	3	30	384.80	56.0	15.7	9.41	2.96	.52	1.84	3.38	.78	.12	.07	<20	130	390	<3	<5	15
10285029	28	5	29	387.79	60.4	15.3	6.90	2.84	.71	2.16	3.28	.89	.13	.39	<20	100	410	<3	9	23
10291040	29	1	40	391.40	57.5	16.1	7.18	3.20	.57	1.97	3.39	.85	.11	.04	<20	240	420	<3	<5	31
10305051	30	5	51	407.01	65.2	13.8	5.59	2.11	1.46	2.69	2.67	.88	.16	.03	<20	240	550	3	17	35
10312081	31	2	81	412.31	60.6	14.6	7.54	2.84	.69	2.22	3.08	.86	.12	.04	<20	90	470	<3	<5	16
10323005	32	3	5	422.55	57.0	15.5	8.84	3.13	.58	1.99	3.47	.80	.14	.04	30	260	870	5	<5	45
10332008	33	2	8	430.58	59.6	14.7	7.38	2.88	1.62	2.12	3.31	.81	.11	.04	<20	260	470	<3	6	18
10342055	34	2	55	440.55	65.5	13.3	4.95	1.86	1.44	2.81	2.85	1.07	.18	.04	<20	100	410	<3	<5	26
10346062	34	6	62	446.62	56.9	16.0	9.42	2.86	.79	1.97	3.75	.86	.13	.06	<20	150	520	<3	<5	16
10346081	34	6	81	446.81	59.8	15.3	8.08	2.60	.79	2.15	3.60	.88	.14	.10	<20	110	320	<3	<5	30
10353075	35	3	75	451.75	56.3	16.0	9.61	2.83	.84	1.90	3.71	.87	.22	.09	<20	120	460	<3	<5	17
10355039	35	5	39	454.39	57.7	14.8	8.64	3.19	1.01	1.97	3.43	.84	.15	.05	50	130	540	3	<5	14
10361075	36	1	75	458.25	58.7	14.5	7.31	3.21	1.84	1.93	3.37	.87	.15	.03	<20	140	520	<3	7	16
10371055	37	1	55	467.55	55.7	15.4	8.96	3.26	1.08	2.05	3.73	.84	.18	.05	<20	130	710	<3	<5	25
10371066	37	1	66	467.66	17.0	4.9	2.04	1.36	39.20	.65	.77	.24	.08	.41	<20	70	250	<3	<5	25
10371067	37	1	66	467.66	16.8	4.8	2.02	1.32	39.70	.63	.86	.23	.08	.42	<20	100	260	<3	10	7
10380139	38	1	39	476.89	54.4	13.4	7.95	4.92	1.57	2.10	3.14	.80	.33	.07	<20	270	540	<3	6	22
10381075	38	1	75	477.25	16.9	4.0	2.25	2.27	39.00	.52	.51	.20	.15	.10	<20	70	1,000	<3	<5	6
10391018	39	1	18	486.18	48.5	10.4	5.67	4.42	9.50	1.73	2.44	.74	.16	.04	<20	100	1,400	<3	10	18
10398000	39	8	0	488.90	31.9	3.2	1.83	1.64	32.00	.63	.55	.18	.11	.03	<20	50	1,200	<3	<5	6
10401012	40	1	12	495.62	57.1	12.0	7.58	4.68	1.35	1.83	3.00	.83	.29	.05	70	120	840	3	12	31
10401013	40	1	12	495.62	57.4	12.2	7.60	4.83	1.18	1.86	3.01	.83	.29	.05	<20	120	840	3	<5	17
10482056	40	4	11	497.55	15.7	3.9	2.01	1.61	40.90	.63	.47	.19	.07	<.02	<20	30	130	<3	5	<5
10404011	40	4	83	500.11	26.0	6.7	3.48	2.64	30.40	.98	1.20	.33	.10	<.02	<20	60	270	<3	<5	10
10404083	40	4	89	500.83	27.9	7.0	3.79	2.58	28.40	1.06	1.46	.38	.09	.02	<20	50	620	<3	<5	9
10404089	40	4	93	500.89	19.0	4.8	2.44	1.90	37.60	.71	.87	.25	.09	<.02	<20	70	550	<3	<5	8
10404093	40	4	98	500.93	6.6	2.0	.63	.90	49.20	.26	.23	.08	.06	<.02	50	90	280	5	<5	6
10404098	41	1	21	500.98	29.4	7.1	3.87	3.01	26.40	.95	1.33	.39	.10	.03	20	50	120	<3	10	<5
10411021	42	1	96	505.21	63.8	7.0	4.03	2.09	8.31	1.15	1.61	.43	<.05	.03	<20	80	220	<3	<5	21
10421096	42	1	115	515.46	38.3	9.3	5.07	2.77	19.90	1.43	2.10	.53	.15	.06	<20	220	590	<3	33	23
10421115	42	1	129	515.65	4.5	1.2	.36	.80	52.40	.15	.15	.02	<.05	.07	<20	20	100	<3	<5	<5
10421129	43	2	131	515.79	24.2	5.3	2.82	1.78	34.20	.74	.86	.28	.06	<.02	<20	110	340	<3	<5	<5
10432131	43	2	133	526.81	38.4	7.3	4.14	2.39	22.40	1.20	1.71	.49	.07	.02	<20	200	550	<3	22	15
10432133	43	2	138	526.83	1.7	.4	.15	.63	54.80	<.15	.02	<.02	<.05	.10	<20	<20	53	<3	<5	<5
10432138	44	1	61	526.88	83.8	5.4	2.29	1.17	.55	1.03	1.31	.34	.06	<.02	20	130	330	<3	490	12
10441061	44	1	132	534.11	56.8	14.2	8.10	4.31	.85	1.82	3.52	.78	.13	.02	<20	150	550	<3	7	15
10441132	45	1	9	534.82	60.0	12.4	6.93	3.88	2.12	1.72	3.03	.71	.11	<.02	<20	140	1,000	<3	<5	20
10451009	47	1	83	543.09	55.4	12.2	8.49	4.43	2.63	2.06	3.05	.77	.38	.04	<20	330	420	<3	22	33
10471083	47	2	39	562.83	3.9	1.2	.41	.73	52.60	.18	.12	.10	.07	.04	<20	30	83	<3	<5	<5
10472039	48	2	10	563.89	48.7	11.1	7.75	4.39	8.02	1.76	2.61	.86	.24	.03	<20	280	360	<3	20	70
10482010	48	2	55	573.10	3.2	1.2	.32	.90	52.30	.23	.10	.04	.10	.18	<20	<20	63	<3	<5	<5
10482055	40	2	55	573.55	3.3	1.1	.34	.89	52.40	<.15	.10	.04	.09	.18	<20	30	66	<3	<5	<5
10491051	49	1	51	581.51	44.8	11.3	5.95	3.73	12.10	1.40	2.55	.77	.27	.04	<20	120	210	<3	15	42
10492015	49	2	15	582.65	54.6	13.1	7.80	4.17	3.51	1.79	3.08	.89	.17	.05	<20	100	200	<3	<5	18
10498000	49	8	0	583.17	1.5	.6	.13	.72	54.70	<.15	.08	<.02	.16	.26	<20	<20	13	<3	9	<5
10501128	50	1	128	591.78	55.4	12.7	8.16	3.90	3.05	1.84	3.53	1.03	.31	.06	<20	80	250	<3	<5	13
10503060	50	3	60	594.10	24.0	5.8	4.12	2.19	32.20	.74	1.25	.39	.08	.19	<20	60	390	<3	<5	10

to a maximum of nonbiogenic material. As expected, the only element associated with the calcareous biogenic component was strontium. Only two elements, Mo and Ba, were associated with the siliceous biogenic component. This latter association is indicated by the fact that concentrations of both Mo and Ba about double in the part of the section rich in siliceous biogenic debris (Fig. 4). This increase in Ba and particularly Mo also is evident in the siliceous part of the section in Hole 530B (Fig. 3). Brongersma-Sanders et al. (1980) reported an association of barium in diatom-rich shelf sediments off Southwest Africa just to the east of Site 532.

Table 2. (Continued).

ppm Cr	ppm Cu	ppm Ga	ppm Li	ppm Mo	ppm Ni	ppm Pb	ppm Sc	ppm Sr	ppm Th	ppm U	ppm V	ppm Zn	ppm Zr	ppm Y	ppm La	ppm Ce	ppm Nd	ppm Dy	ppm Yb	% CaCO3
67	42	60	49	15	38	<20	11	920	10	<100	59	59	<10	16	23	40	<50	<5	2	47.9
94	39	<20	36	7	42	<20	12	620	<10	<100	64	74	30	17	8	40	<50	<5	<2	38.4
110	48	50	74	<5	61	<20	8	1,200	40	100	90	93	90	21	14	80	<50	35	5	49.8
180	49	70	94	<5	74	<20	26	430	20	200	160	110	170	35	31	100	<50	16	6	15.8
160	49	<20	72	<5	67	<20	25	380	60	<100	130	110	120	30	26	70	100	22	2	16.3
170	40	30	75	7	84	<20	18	310	30	<100	120	110	160	27	30	60	70	8	2	11.3
100	44	<20	49	<5	50	<20	16	780	20	<100	120	86	20	21	25	60	<50	6	<2	37.3
240	58	110	77	<5	63	70	32	220	100	700	140	100	150	38	47	200	190	75	7	6.9
220	76	120	82	15	91	20	16	920	40	200	120	120	120	32	30	70	80	28	4	4.2
97	49	100	48	17	41	120	21	1,300	110	600	64	74	30	24	55	150	60	44	<2	65.5
75	32	60	43	<5	27	<20	7	1,400	10	<100	59	41	<10	15	23	<30	<50	<5	2	65.9
42	20	30	22	<5	31	<20	8	1,100	20	<100	32	22	<10	11	20	<30	60	<5	<2	75.2
130	65	60	59	6	68	30	16	1,000	20	200	120	120	100	19	27	70	60	17	<2	46.2
120	48	<20	93	<5	38	<20	16	230	20	<100	130	61	90	14	23	<30	<50	13	2	7.6
140	47	50	80	<5	49	<20	21	610	<10	<100	110	110	130	26	33	60	<50	8	3	25.2
63	31	<20	34	<5	27	<20	8	970	<10	<100	54	67	10	15	6	<30	<50	<5	<2	55.5
210	53	40	110	<5	90	20	25	190	10	<100	160	110	200	37	40	70	<50	19	5	4.1
30	25	<20	30	<5	18	<20	<5	1,300	20	<100	49	29	40	9	<5	<30	<50	14	<2	72.1
130	21	<20	57	<5	43	<20	14	190	<10	<100	100	61	160	22	17	<30	<50	<5	3	5.9
110	55	20	57	<5	34	<20	18	930	10	<100	120	100	10	25	31	50	<50	6	<2	41.1
160	40	<20	82	<5	39	<20	23	150	10	<100	120	94	130	22	30	60	<50	8	3	3.3
170	36	<20	86	<5	39	<20	19	150	10	<100	140	86	140	23	25	40	60	12	4	3.3
63	35	<20	46	<5	16	<20	5	1,100	<10	<100	83	51	70	12	<5	<30	60	19	2	54.8
150	34	<20	54	<5	53	<20	17	410	<10	<100	100	92	90	23	19	50	<50	<5	3	20.0
150	24	60	48	10	140	<20	13	310	10	<100	81	65	140	33	32	100	<50	13	6	11.0
40	40	<20	27	<5	13	<20	<5	1,400	<10	<100	71	30	40	11	6	<30	<50	<5	<2	70.5
150	63	30	74	<5	81	20	26	220	20	<100	170	150	70	30	34	90	<50	7	2	6.7
58	30	<20	36	<5	9	<20	5	1,000	10	<100	65	47	50	15	<5	<30	60	15	<2	60.5
160	91	30	90	<5	99	20	31	140	20	<100	150	140	80	36	39	90	<50	11	3	2.5
110	55	50	67	<5	64	<20	19	150	<10	<100	140	110	170	24	36	80	<50	13	3	3.0
160	77	50	110	<5	71	<20	26	130	<10	<100	160	130	220	34	34	110	<50	<5	5	1.8
120	56	20	95	<5	61	<20	27	90	<10	<100	110	110	120	25	30	70	60	13	3	.9
150	91	50	110	<5	94	<20	29	110	<10	<100	150	140	200	37	40	100	60	12	6	1.0
110	58	30	81	<5	72	<20	26	95	20	100	120	140	120	26	37	110	<50	15	4	1.4
120	59	<20	79	<5	54	<20	19	100	10	<100	130	140	130	21	28	40	<50	16	3	1.2
160	67	<20	73	<5	66	20	27	97	50	<100	140	130	120	27	30	80	110	48	6	.8
160	120	30	77	<5	94	60	34	130	60	300	120	140	140	41	44	120	<50	40	4	2.8
20	9	<20	10	<5	14	70	<5	1,000	<10	<100	24	27	<10	10	15	<30	<50	<5	<2	87.0
130	33	<20	44	<5	66	<20	23	110	10	<100	170	120	100	28	27	80	<50	13	3	1.2
160	41	60	54	<5	77	<20	28	120	10	100	130	130	160	37	41	110	<50	22	3	1.2
160	41	<20	42	<5	46	<20	24	100	<10	<100	120	100	110	25	26	70	<50	11	3	1.0
140	39	<20	44	<5	39	<20	20	100	<10	<100	110	90	120	24	22	50	<50	10	2	1.0
210	67	100	84	<5	75	30	30	160	40	100	190	150	180	42	47	130	<50	16	5	1.9
99	55	<20	62	<5	48	<20	18	110	10	<100	130	95	110	17	28	30	60	12	2	.9
160	47	<20	60	<5	74	<20	22	110	20	<100	130	150	160	29	25	60	60	15	4	1.3
130	43	40	53	<5	67	<20	18	110	20	<100	150	160	130	22	28	80	70	34	<2	1.0
170	58	60	44	<5	76	<20	17	210	10	200	150	130	340	41	38	80	<50	7	7	2.6
140	44	<20	37	<5	57	<20	18	120	<10	<100	110	140	170	29	21	<30	<50	<5	2	1.2
330	87	20	100	<5	120	40	55	250	30	<100	270	270	290	65	74	180	110	27	8	1.0
160	35	40	58	<5	54	<20	25	160	20	100	130	86	30	25	29	70	70	16	5	2.9
110	32	<20	36	<5	82	<20	12	180	<10	<100	120	110	290	24	27	40	<50	21	4	2.6
120	42	<20	68	<5	44	<20	23	130	<10	<100	120	120	140	19	28	50	<50	<5	2	1.4
140	48	<20	51	<5	110	<20	20	120	<10	<100	100	110	130	26	27	60	<50	7	3	1.4
140	44	<20	56	<5	50	<20	23	120	<10	<100	94	120	110	33	33	90	<50	<5	2	1.5
170	99	<20	59	<5	51	<20	25	140	<10	<100	150	130	160	26	23	70	<50	17	3	1.8
170	34	60	73	<5	53	<20	26	200	<10	<100	140	110	280	40	41	100	<50	24	5	3.3
140	54	40	74	<5	82	20	28	160	20	<100	120	150	80	33	36	90	<50	11	3	1.9
74	28	130	35	12	32	30	20	730	40	1,000	39	62	20	30	19	190	<50	<5	<2	70.0
49	22	80	32	<5	33	<20	17	810	30	100	46	54	60	18	<5	90	<50	32	<2	70.9
160	65	40	77	<5	80	<20	26	170	20	<100	130	130	20	35	38	70	<50	20	4	2.8
40	22	40	14	<5	20	<20	7	430	10	<100	39	45	30	17	8	40	<50	<5	2	69.6
110	46	<20	52	<5	55	<20	12	300	10	<100	110	100	110	17	13	<30	<50	6	2	17.0
52	31	<20	18	<5	14	<20	8	550	<10	<100	34	47	<10	15	17	<30	<50	<5	<2	57.1
190	86	70	72	9	85	80	31	260	150	400	140	130	120	44	50	120	330	150	12	2.4
180	8	40	28	<5	52	<20	24	240	<10	200	67	110	90	42	38	140	<50	<5	<2	2.1
28	14	20	22	<5	16	<20	<5	700	<10	900	18	25	30	8	<5	<30	<50	<5	<2	73.0
52	25	<20	31	<5	33	<20	9	630	<10	<100	44	68	20	13	<5	30	<50	<5	<2	54.3
64	31	30	37	<5	36	20	8	580	30	<100	53	74	60	13	7	30	60	24	<2	50.7
51	26	20	22	<5	44	<20	7	750	20	<100	41	64	<10	15	21	40	<50	<5	<2	67.1
31	28	<20	19	<5	7	160	15	570	100	300	18	45	<10	10	49	<30	<50	38	4	87.9
59	34	<20	31	<5	32	<20	<5	510	20	<100	50	52	60	7	<5	<30	70	25	<2	47.1
78	45	20	35	<5	73	<20	13	350	10	<100	75	84	90	10	14	30	<50	<5	<2	14.8
120	58	60	70	<5	63	40	13	680	50	200	100	120	110	28	30	110	<50	28	2	35.5
16	13	<20	5	<5	12	<20	<5	280	<10	<100	18	28	<10	8	22	<30	<50	<5	<2	93.6
32	12	30	25	<5	13	<20	9	910	20	<100	42	50	40	7	10	<30	<50	<5	<2	61.1
130	81	120	49	<5	54	30	14	820	40	200	100	82	90	20	17	60	90	13	<2	40.0
7	35	<20	<5	<5	15	<20	<5	230	<10	<100	10	24	<10	<5	<5	<30	<50	<5	<2	97.9
78	29	40	29	<5	57	20	6	100	20	100	58	51	110	16	22	60	<50	17	<2	1.0
150	80	<20	83	<5	57	<20	22	200	10	<100	140	110	110	21	25	40	<50	17	<2	1.5
190	52	40	71	<5	70	<20	26	230	20	100	130	110	40	23	29	80	<50	<5	<2	3.8
170	59	80	92	<5	120	<20	23	420	30	200	160	160	160	47	43	60	<50	14	5	4.7
20	<5	40	<5	<5	<5	<20	<5	290	10	100	7	19	<10	9	18	<30	<50	6	<2	93.9
220	100	60	97	<5	150	<20	29	280	20	200	180	140	150	37	33	60	<50	23	<2	14.3
20	7	<20	5	<5	<5	<20	<5	340	<10	<100	15	19	<10	9	<5	<30	<50	<5	<2	93.4
21	<5	40	<5	<5	10	<20	<5	360	20	<100	15	12	<10	9	21	<30	<50	9	<2	93.6
150	91	<20	70	<5	120	<20	18	310	10	<100	150	76	120	33	26	40	<50	12	3	21.6
140	42	<20	42	<5	56	20	20	190	<10	<100	140	120	80	24	20	40	<50	6	3	6.3
18	180	130	<5	<5	7	<20	<5	320	<10	<100	33	<5	10	27	18	90	<50	<5	4	97.7
190	58	<20	51	<5	66	<20	17	200	<10	<100	140	140	150	27	15	<30	<50	<5	<2	5.4
55	47	<20	33	<5	37	<20	10	430	<10	<100	47	62	40	12	10	<30	<50	12	2	57.5

DISCUSSION

Mid-Cretaceous Black Shales, Site 530

The element plots for Hole 530A (Fig. 2) show that concentrations of some elements are obviously elevated in samples from lithologic Unit 8, the red, green, and black claystone and shale of Albian to Coniacian age. These plots do not, however, differentiate between different colored lithologies and do not compensate for the diluting effect of $CaCO_3$. Summary statistics on a carbonate-free basis for 12 samples of red claystone, 27 samples of green claystone, and 28 samples of black

Table 2. (Continued).

Sample	Core	Section	Interval	DEPTH m	% SiO2	% Al2O3	% Fe2O3	% MgO	% CaO	% Na2O	% K2O	% TiO2	% P2O5	% MnO	ppm As	ppm B	ppm Ba	ppm Be	ppm Cd	ppm Co
10503070	50	3	70	594.20	20.9	5.1	3.55	1.93	35.40	.62	1.15	.34	.08	.16	<20	30	92	<3	<5	8
10504044	50	4	44	595.44	46.4	11.0	6.67	3.20	11.60	1.82	2.99	.89	.19	.12	<20	70	250	<3	7	19
10512111	51	2	111	602.61	56.6	12.9	7.97	3.92	2.70	2.12	3.46	.91	.25	.09	<20	300	460	3	22	41
10515058	51	5	58	606.58	46.5	3.5	1.83	1.19	24.20	.72	.84	.23	.12	.06	<20	50	460	<3	<5	<5
10515059	51	5	58	606.58	46.9	3.5	1.83	1.22	24.00	.68	.84	.24	.12	.06	<20	70	500	<3	<5	7
10521069	52	1	64	610.14	58.7	12.1	7.62	3.74	2.62	1.81	3.10	.75	.16	.03	<20	130	550	<3	12	27
10531040	53	1	40	619.40	56.4	10.2	6.99	3.50	6.27	1.75	2.62	.85	.23	.06	<20	90	600	<3	<5	25
10531130	53	1	130	620.30	20.0	4.0	2.67	1.64	38.10	.79	.78	.48	.24	.07	<20	40	180	<3	<5	9
10541030	54	1	30	628.80	1.9	.6	.15	.70	54.20	<.15	.03	<.02	.07	.09	<20	<20	47	<3	<5	<5
10541057	54	1	57	629.07	61.0	8.6	5.59	3.19	5.79	1.78	2.20	.92	.27	.03	50	80	320	<3	9	38
10553036	55	3	36	641.36	4.1	1.3	.64	.67	52.30	.30	.16	.22	.11	.05	<20	30	63	<3	7	<5
10555066	55	5	66	644.66	40.6	5.7	3.34	2.01	23.90	.93	1.53	.41	.18	.03	<20	120	230	<3	<5	10
10555067	55	5	66	644.66	40.4	5.7	3.32	1.99	24.10	.94	1.54	.41	.18	.03	<20	50	180	<3	<5	9
10561092	56	1	92	648.42	26.7	3.5	1.99	1.38	35.70	.67	.77	.24	.09	.04	<20	140	180	7	<5	130
10561123	56	1	123	648.73	39.4	6.8	4.36	2.37	22.50	1.23	1.75	.65	.20	<.02	<20	60	250	<3	<5	14
10562090	56	2	90	649.90	37.9	3.6	2.24	1.36	29.20	.50	.89	.25	.08	.04	<20	60	130	<3	14	11
10571117	57	1	117	658.17	19.9	4.0	2.19	1.30	39.20	.71	.79	.47	.12	.13	<20	40	280	<3	12	<5
10581031	58	1	31	666.81	60.5	13.3	6.94	3.55	1.91	2.33	3.42	1.05	.36	.03	<20	100	390	<3	<5	14
10591118	59	1	118	677.18	52.4	8.0	3.27	1.75	15.40	1.64	2.07	.62	.28	.04	<20	70	390	<3	<5	<5
10601121	60	1	121	686.71	49.0	7.9	4.67	2.65	15.30	1.40	1.97	.86	.17	.06	<20	70	340	<3	9	12
10611087	61	1	87	695.87	55.2	11.7	7.70	3.71	5.28	2.07	3.00	1.40	.27	.05	<20	230	580	<3	7	31
10612130	61	2	130	697.80	35.3	8.3	5.25	2.84	22.20	1.27	1.84	.73	.14	.11	<20	140	800	<3	<5	17
10615012	61	5	12	701.12	44.8	10.8	3.31	1.79	17.60	2.31	2.15	1.91	.22	.16	<20	40	610	<3	<5	11
10622079	62	2	79	706.79	44.4	8.1	3.94	1.79	15.50	2.08	1.70	.37	.10	<.02	<20	60	380	<3	<5	21
10633076	63	3	76	717.76	40.2	5.2	3.86	1.88	24.30	.92	1.25	.53	.11	.15	<20	30	240	<3	<5	11
10633079	63	3	79	717.79	42.4	7.4	5.56	2.69	18.90	1.24	1.93	.80	.19	.10	<20	160	410	<3	6	21
10633121	63	3	121	718.21	16.1	4.7	3.74	2.63	39.30	1.10	.45	1.28	.22	.22	<20	20	120	<3	12	13
10633122	63	3	121	718.21	15.9	4.6	3.73	2.70	39.30	1.13	.41	1.28	.21	.22	<20	<20	80	<3	<5	10
10638007	63	8	7	718.57	29.0	7.1	6.06	4.41	26.70	1.72	.83	1.58	.32	.14	<20	40	160	<3	<5	17
10641125	64	1	125	724.75	48.6	8.9	6.46	2.76	13.40	1.51	2.20	.98	.21	.09	<20	70	290	<3	20	18
10642068	64	2	68	725.68	34.6	9.5	8.59	5.09	20.70	2.30	.96	3.21	.46	.18	50	<20	220	<3	<5	31
10643013	64	3	13	726.63	59.7	10.8	7.92	3.37	3.56	1.73	2.67	1.03	.19	.06	<20	190	410	<3	<5	25
10671098	67	1	98	752.98	34.3	10.5	8.27	2.35	20.40	2.43	1.34	2.92	.49	.18	<20	<20	480	<3	8	18
10671106	67	1	106	753.06	40.7	5.6	4.23	1.83	23.40	.97	1.38	.58	.16	.13	<20	60	420	<3	11	20
10683035	68	3	35	764.85	42.1	9.6	4.64	1.43	19.80	2.19	1.84	1.96	.25	.20	<20	30	690	<3	<5	14
10686062	68	6	62	769.62	57.0	8.5	6.88	2.41	8.51	1.55	2.01	1.17	.34	.07	<20	30	920	<3	5	8
10691092	69	1	92	771.92	42.9	9.1	6.38	2.04	17.90	1.98	1.33	1.80	.31	.20	<20	50	370	<3	<5	16
10691093	69	1	92	771.92	45.3	8.1	5.98	2.01	17.60	1.59	1.35	1.44	.25	.15	<20	140	420	<3	<5	22
10693076	69	3	78	774.78	50.3	13.2	6.25	2.36	9.49	2.36	.86	2.73	.21	.05	<20	50	860	<3	<5	21
10703134	70	3	134	784.84	57.1	7.4	5.65	2.07	11.20	1.20	2.03	.78	.29	.14	<20	40	120	<3	<5	14
10704009	70	4	9	785.09	49.9	13.9	13.60	2.98	4.47	3.11	1.02	3.18	.53	.07	<20	60	150	<3	<5	47
10704034	70	4	34	785.34	39.8	12.1	11.20	3.24	13.50	2.58	.67	2.99	.38	.25	<20	60	320	<3	<5	34
10711131	71	1	131	791.31	46.1	9.2	7.00	2.93	13.50	1.34	2.69	1.02	.37	.11	<20	70	150	<3	<5	23
10713112	71	3	112	794.12	34.7	10.9	12.90	6.26	14.90	2.68	.43	2.71	.42	.20	<20	330	200	<3	28	75
10722052	72	2	52	801.52	42.8	10.9	7.04	2.85	14.40	1.27	4.73	1.37	.20	.20	<20	180	130	<3	6	16
10722078	72	2	78	801.78	45.80	13.40	12.70	7.97	3.08	4.86	.84	3.11	.47	.10	<20	40	91	<3	13	56
10722145	72	2	145	802.45	45.30	13.30	13.30	8.15	3.50	4.93	.63	3.34	.46	.12	<20	<20	62	<3	<5	48
10723027	72	3	27	802.77	41.00	12.90	13.80	7.62	7.13	3.76	.86	3.30	.52	.20	50	30	610	<3	10	66
10748001	74	8	1	824.08	37.10	11.40	8.64	2.16	16.80	1.80	.35	2.76	.47	.31	<20	30	36	<3	<5	36
10748002	74	8	1	824.08	36.60	11.30	8.52	2.17	17.00	1.73	.32	2.70	.46	.31	<20	250	39	<3	190	56
10752123	75	2	123	830.73	48.60	15.60	10.40	2.97	4.38	2.10	.22	3.93	.34	.27	<20	50	420	<3	<5	47
10754124	75	4	126	833.76	60.40	14.70	7.78	2.04	1.25	2.49	2.90	2.20	.28	<.02	<20	50	540	<3	<5	16
10761071	76	1	71	838.21	54.50	18.70	5.61	3.01	1.75	2.39	.27	4.64	.40	<.02	<20	80	100	<3	<5	97
10765110	76	5	110	844.60	48.70	14.50	8.33	2.63	6.73	1.85	.80	3.32	.58	.26	<20	190	1,300	<3	<5	49
10771148	77	1	148	848.48	51.20	16.00	6.50	2.81	6.32	2.10	.53	3.28	.14	.03	<20	210	1,300	<3	21	41
10772142	77	2	142	849.92	51.80	15.30	6.18	2.58	6.30	2.05	.65	3.04	.18	.06	<20	80	2,200	<3	<5	37
10773138	77	3	138	851.38	42.60	11.20	12.20	2.58	10.80	2.08	1.66	2.61	1.11	.12	<20	50	510	<3	<5	32
10781016	78	1	16	856.66	35.40	6.47	4.83	1.47	26.00	.92	1.26	.55	.08	.19	<20	140	430	<3	14	21
10781098	78	1	98	857.48	44.70	10.20	10.60	2.29	11.90	1.82	1.75	1.85	.44	.08	<20	40	570	<3	<5	28
10781123	78	1	123	857.73	46.90	14.10	7.42	2.49	9.47	2.38	.49	3.37	.28	.06	<20	40	1,300	<3	<5	34
10791062	79	1	62	866.62	48.70	12.50	12.00	2.52	6.66	1.93	2.31	2.17	.38	.04	<20	90	370	<3	<5	39
10794013	79	4	13	870.63	52.50	16.60	5.54	2.73	5.39	2.04	.83	3.69	.26	.03	<20	210	1,100	<3	520	46
10795140	79	5	140	873.40	37.60	7.30	5.19	1.48	23.60	1.07	1.52	.76	.14	.12	<20	140	600	<3	8	17
10801053	80	1	53	876.03	41.40	8.79	6.72	1.80	18.40	1.27	1.69	1.43	.16	.07	<20	60	910	<3	8	24
10801071	80	1	71	876.21	44.10	9.73	7.95	1.89	15.30	1.52	1.90	1.65	.30	.08	<20	50	660	<3	9	29
10801072	80	1	71	876.21	43.80	9.62	7.94	1.80	15.60	1.63	1.86	1.68	.31	.08	<20	40	510	<3	<5	23
10811122	81	1	122	886.22	39.00	7.88	8.23	5.32	14.90	1.30	1.83	1.08	.24	.30	<20	50	430	<3	<5	27
10821044	82	1	44	894.94	52.90	11.70	6.22	1.88	9.06	2.22	2.20	2.81	.30	.07	<20	150	2,200	<3	<5	25
10822073	82	2	73	896.73	28.50	5.57	3.73	1.44	31.20	.88	1.26	.81	.15	.17	30	40	980	<3	<5	13
10825111	82	5	111	901.61	58.20	11.70	8.00	2.15	4.96	2.01	2.89	1.31	.17	.05	30	90	500	<3	9	17
10831079	83	1	79	904.79	52.80	10.80	9.17	2.58	7.90	1.57	2.63	1.24	.14	.09	<20	270	450	<3	27	29
10833061	83	3	61	907.61	37.60	6.94	4.43	1.41	24.30	.92	1.61	.68	.09	.13	<20	30	1,400	<3	<5	13
10842018	84	2	18	914.68	50.00	12.10	8.48	2.61	8.79	1.53	2.89	1.15	.15	.08	<20	90	470	<3	<5	19
10842115	84	2	115	915.65	36.60	7.41	7.50	7.25	14.60	1.08	1.86	.75	.11	.29	20	30	200	<3	20	41
10851006	85	1	6	922.06	28.70	7.01	8.03	7.62	19.00	1.21	1.74	.98	.13	.48	<20	210	440	<3	23	53
10851007	85	1	6	922.06	28.80	6.97	7.97	7.55	18.80	1.22	1.71	.97	.13	.47	<20	180	390	<3	9	42
10852010	85	2	10	923.60	46.00	11.50	10.20	2.86	9.57	1.63	2.71	1.54	.17	.07	<20	90	360	<3	<5	28
10852067	85	2	67	924.17	13.40	.35	<.04	.50	47.60	<.15	.04	<.02	<.05	1.03	<20	30	24	<3	<5	<5
10854042	85	4	42	926.92	57.70	13.10	7.77	2.96	2.30	1.67	3.58	1.42	.20	.06	<20	100	390	<3	<5	180
10856065	85	6	65	930.15	35.50	8.31	5.18	1.79	23.30	1.01	2.09	.81	.14	.23	20	120	750	<3	<5	20
10861082	86	1	82	931.82	47.30	11.00	8.49	3.64	9.41	1.37	2.90	1.31	.20	.28	<20	60	1,500	<3	<5	17
10866065	86	6	65	939.15	57.40	13.60	8.25	2.82	2.14	1.71	3.56	1.55	.25	.10	50	80	590	<3	7	28
10866089	86	6	89	939.39	37.70	8.98	7.09	2.60	19.10	1.16	2.31	.87	.17	.50	<20	60	1,600	<3	<5	12
10873081	87	3	81 r	943.81	57.30	13.70	10.70	2.90	.71	1.62	3.75	1.30	.13	.09	<20	80	460	<3	<5	<5
10874064	87	4	64 g	945.14	56.40	13.90	8.41	3.21	1.81	1.62	3.70	1.36	.15	.25	<20	260	780	<3	7	23
10874080	87	4	80 b	945.30	45.00	11.60	11.70	2.27	1.18	1.52	3.12	1.23	.20	.08	80	60	2,600	<3	38	93
10882114	88	2	114 r	951.64	53.50	13.10	10.50	2.77	3.98	1.45	3.74	1.32	.23	.33	<20	60	770	<3	6	7
10883029	88	3	29 b	952.29	46.80	12.00	10.40	2.30	1.25	1.43	3.48	1.09	.27	.04	90	310	4,300	3	31	150
10883084	88	3	84 g	952.84	59.90	14.60	6.49	2.94	.91	1.59	4.12	1.44	.16	.04	<20	130	1,300	<3	<5	13
10891065	89	1	65 b	958.65	56.20	14.40	9.51	2.67	.76	1.71	3.83	1.39	.14	.08	<20	220	1,500	<3	8	41

shale from lithologic Unit 8 are given in Table 6 and plotted in Figure 7. These samples are indicated in Table 2 by "r" (red), "g" (green), and "b" (black) following the interval designations for samples. Carbonate-free concentrations of each element were calculated by dividing the bulk concentration, in percent or parts per million, by the fraction of noncarbonate material. For example, if a sample contains 25% $CaCO_3$ (noncarbonate fraction = 0.75) and 90 ppm Cu, then the carbonate-free concentration of Cu is 90/0.75 = 120 ppm. For purposes of this calculation, percent $CaCO_3$ was determined by the total-Ca (XRF) analysis. Figure 8 is a plot

Table 2. (Continued).

ppm Cr	ppm Cu	ppm Ga	ppm Li	ppm Mo	ppm Ni	ppm Pb	ppm Sc	ppm Sr	ppm Th	ppm U	ppm V	ppm Zn	ppm Zr	ppm Y	ppm La	ppm Ce	ppm Nd	ppm Dy	ppm Yb	% CaCO3
40	35	40	25	<5	25	<20	7	500	20	<100	43	65	50	14	11	60	<50	20	<2	63.2
110	57	<20	47	<5	59	40	19	280	20	<100	310	110	130	28	19	50	50	16	3	20.7
180	62	80	87	<5	110	40	24	350	40	200	170	160	170	43	45	110	50	27	6	4.8
19	27	<20	18	<5	13	<20	<5	380	<10	<100	34	40	20	8	<5	<30	<50	<5	<2	43.2
37	27	<20	20	<5	25	20	8	420	10	<100	44	50	<10	17	20	40	<50	<5	<2	42.9
130	130	40	76	<5	97	<20	21	300	20	<100	140	190	170	27	22	60	<50	11	4	4.7
100	56	20	45	<5	61	<20	23	300	<10	100	100	130	100	31	31	80	<50	<5	<2	11.2
52	28	<20	18	<5	18	<20	7	380	<10	200	48	36	40	13	5	<30	<50	23	<2	68.0
13	16	<20	<5	<5	<5	<20	<5	250	<10	<100	<5	<5	<10	<5	<5	<30	<50	<5	<2	96.8
100	68	80	59	<5	110	60	24	240	140	400	130	100	110	29	26	120	290	130	8	10.3
46	99	40	<5	<5	10	30	<5	340	<10	200	26	85	30	12	10	40	80	26	<2	93.4
43	25	<20	42	<5	34	<20	11	380	<10	<100	62	54	<10	18	21	<30	<50	<5	<2	42.7
41	19	<20	29	<5	25	<20	9	310	<10	<100	52	53	20	18	9	<30	<50	<5	<2	43.0
200	16	1,500	150	110	70	510	120	380	500	8,100	46	27	80	140	420	1,600	<50	<5	<2	63.7
58	32	<20	37	<5	38	<20	13	420	10	<100	80	75	40	26	29	60	<50	<5	<2	40.2
18	16	60	35	<5	25	<20	6	420	<10	<100	37	49	70	13	19	<30	<50	<5	<2	52.1
45	110	70	21	<5	13	<20	8	440	<10	<100	67	57	90	18	23	30	90	7	<2	70.0
120	28	<20	47	<5	45	<20	15	230	<10	<100	110	94	180	29	33	40	<50	<5	2	3.4
56	29	<20	34	<5	13	<20	7	370	10	<100	90	42	90	18	19	<30	<50	17	3	27.5
93	39	<20	36	<5	39	<20	10	240	10	<100	110	53	100	14	11	<30	60	15	3	27.3
160	47	60	51	<5	72	<20	25	300	<10	<100	160	110	40	35	38	80	60	18	5	9.4
120	64	<20	89	<5	65	<20	18	1,500	20	<100	150	120	160	27	25	70	60	16	3	39.6
170	62	<20	26	<5	25	<20	15	400	<10	<100	150	100	160	22	17	30	50	17	3	31.4
97	41	<20	35	<5	55	<20	19	410	10	<100	140	110	230	29	30	70	<50	<5	<2	27.7
40	26	<20	27	<5	34	<20	8	340	<10	<100	65	59	30	13	6	<30	<50	8	<2	43.4
69	48	60	36	<5	54	<20	11	390	20	100	120	56	<10	23	28	60	<50	18	<2	33.7
270	18	90	13	<5	38	<20	21	540	<10	<100	150	69	130	19	21	40	<50	<5	<2	70.2
240	25	<20	<5	<5	29	<20	14	410	<10	<100	120	53	60	11	<5	<30	<50	<5	<2	70.2
300	39	<20	27	<5	59	<20	20	590	<10	<100	160	79	110	12	9	<30	<50	<5	<2	47.7
51	36	<20	34	<5	44	<20	10	270	10	<100	140	63	130	21	16	<30	<50	20	3	23.9
740	72	<20	13	7	84	50	40	580	40	100	320	110	200	38	43	60	100	36	5	37.0
38	42	<20	32	<5	63	<20	7	220	<10	<100	120	85	140	18	20	40	70	7	3	6.4
200	67	<20	10	<5	37	<20	19	480	<10	<100	230	100	200	30	22	40	<50	12	9	36.4
45	21	70	36	<5	34	20	10	450	<10	<100	92	71	120	24	27	<30	<50	<5	2	41.8
140	32	<20	11	<5	24	<20	11	360	<10	<100	120	100	110	25	18	40	<50	<5	2	35.4
68	29	<20	27	<5	41	<20	9	250	<10	<100	95	66	140	18	12	<30	<50	<5	<2	15.2
80	110	<20	20	<5	30	<20	14	420	<10	<100	150	88	160	17	27	40	<50	<5	<2	32.0
63	82	<20	21	<5	35	<20	7	400	20	200	150	84	150	17	12	40	50	7	<2	31.4
200	140	<20	26	<5	45	<20	20	420	<10	<100	250	120	220	12	19	<30	<50	15	3	16.9
68	37	<20	27	<5	55	<20	15	230	<10	<100	100	48	90	23	17	40	<50	<5	<2	20.0
180	140	40	20	<5	160	<20	28	540	<10	<100	300	170	190	36	36	100	<50	7	3	8.0
200	120	30	30	<5	93	<20	30	510	<10	200	270	100	220	19	29	80	<50	10	3	24.1
72	50	<20	33	<5	80	<20	13	280	<10	<100	160	83	140	26	25	40	50	20	<2	24.1
350	130	120	36	<5	160	<20	45	450	40	200	400	130	300	38	36	140	70	38	7	26.6
48	44	60	17	<5	67	<20	27	250	20	<100	310	33	20	15	24	50	<50	13	4	25.7
210	140	50	22	<5	85	<20	35	340	<10	<100	350	140	360	43	40	90	70	12	4	5.5
230	120	<20	13	<5	79	<20	30	240	<10	<100	310	110	190	30	24	60	<50	<5	3	6.2
300	180	<20	50	<5	130	<20	38	370	130	<100	390	140	250	39	29	80	350	150	10	12.7
140	69	<20	20	<5	53	<20	21	310	<10	<100	210	110	190	32	24	70	50	14	3	30.0
210	110	60	30	<5	68	<20	20	420	20	100	310	110	320	43	42	90	<50	29	8	30.4
58	100	<20	22	<5	35	<20	26	390	<10	<100	320	68	320	29	45	70	60	20	4	7.8
81	110	30	16	<5	38	20	20	290	10	<100	180	190	300	43	36	80	50	15	5	2.2
200	71	<20	13	<5	110	<20	12	390	<10	<100	280	110	390	26	31	<30	<50	<5	<2	3.1
270	79	40	<5	<5	81	<20	29	460	50	<100	260	120	310	41	49	160	70	16	3	12.0
570	250	70	12	<5	170	<20	22	450	40	200	330	130	320	17	47	120	<50	<5	5	11.3
420	230	30	8	<5	120	<20	22	490	<10	<100	300	130	190	15	58	90	<50	5	2	11.2
100	69	<20	17	<5	89	<20	16	440	<10	<100	190	110	260	38	34	60	70	22	3	19.3
140	11	100	26	<5	60	<20	34	500	10	300	140	51	250	37	16	80	<50	31	6	46.4
150	30	<20	17	<5	86	<20	20	350	<10	<100	160	90	150	25	18	60	<50	13	2	21.2
220	310	<20	21	<5	80	<20	15	430	<10	<100	290	120	230	19	24	<30	70	20	3	16.9
65	73	<20	24	<5	91	<20	18	380	<10	<100	220	160	170	32	33	50	<50	14	<2	11.9
130	170	80	22	<5	88	<20	9	770	30	200	270	140	300	31	88	190	90	53	3	9.6
49	12	60	21	<5	37	<20	8	360	20	200	98	70	50	23	23	60	60	17	3	42.1
89	160	60	31	<5	58	<20	15	510	<10	<100	150	120	300	25	34	80	60	9	3	32.9
62	30	60	30	<5	62	<20	17	480	<10	<100	150	110	320	35	37	90	<50	9	<2	27.3
56	22	<20	21	<5	49	<20	13	390	<10	<100	110	97	170	27	21	70	<50	11	<2	27.9
52	28	<20	23	<5	44	<20	11	230	<10	<100	99	98	200	27	25	60	<50	18	3	26.6
220	280	30	23	<5	60	<20	15	420	<10	<100	210	82	90	24	39	70	<50	<5	5	16.2
49	25	<20	15	<5	38	<20	11	430	<10	<100	70	66	60	30	35	70	<50	<5	<2	55.7
100	33	20	32	9	60	20	16	270	<10	<100	130	87	190	24	21	40	<50	21	2	8.9
140	28	100	44	<5	87	<20	26	390	40	200	190	130	270	33	30	110	<50	23	5	14.1
53	19	<20	19	<5	37	<20	15	470	<10	<100	78	64	70	20	10	50	<50	<5	<2	43.4
78	56	30	45	<5	76	<20	23	390	10	<100	150	120	130	30	46	120	<50	12	3	15.7
69	22	30	26	<5	76	20	13	250	40	<100	130	120	190	24	22	60	110	57	5	26.1
92	24	140	23	<5	88	20	25	360	10	300	150	150	250	29	31	120	<50	33	2	33.9
77	21	<20	23	<5	67	<20	11	310	<10	<100	120	120	60	23	29	40	<50	9	3	33.6
120	35	40	35	<5	93	<20	26	400	20	<100	150	130	120	28	38	100	<50	12	3	17.1
<5	<5	40	<5	<5	<5	<20	6	160	<10	100	14	14	70	14	22	<30	<50	<5	<2	85.0
93	41	<20	38	<5	170	<20	16	250	20	<100	190	97	200	25	54	90	60	16	3	4.1
46	25	<20	14	<5	45	<20	14	460	<10	<100	110	66	110	25	19	60	<50	6	<2	41.6
81	120	<20	25	<5	65	<20	18	290	<10	<100	150	130	210	29	17	<30	90	38	4	16.8
100	82	30	60	<5	71	60	25	290	100	200	120	140	120	32	33	140	240	96	7	3.8
50	17	<20	18	<5	44	<20	24	390	<10	<100	100	85	130	30	32	50	<50	<5	3	34.1
110	29	<20	10	<5	40	<20	7	220	<10	<100	180	100	170	10	6	<30	<50	<5	<2	1.3
140	75	60	35	<5	97	<20	32	230	30	100	190	73	70	34	45	110	70	26	5	3.2
290	220	<20	28	23	360	<20	10	190	<10	<100	1,000	1,800	180	22	8	<30	<50	13	5	2.1
100	46	<20	18	<5	40	<20	14	180	<10	900	120	66	170	31	25	50	<50	<5	2	7.1
450	320	40	49	25	390	<20	17	240	10	<100	1,300	1,400	60	45	44	130	90	9	7	2.2
190	95	<20	53	<5	48	<20	22	230	<10	<100	310	130	240	24	39	90	<50	17	4	1.6
98	81	20	31	<5	65	<20	23	210	<10	<100	280	350	190	22	29	60	<50	<5	3	1.4

of $CaCO_3$ determined by the total-Ca method and by the shipboard carbonate-bomb method in 121 samples that either were splits of the same sample or were collected in close proximity within relatively homogeneous lithologies. Figure 8 shows that there is good agreement between the two methods.

It is apparent from Table 6 and Figure 7 that concentrations of Co, Cr, Cu, Mo, Ni, V, and Zn are considerably higher in black-shale than in either red or green claystone. The enrichment of certain trace elements—especially Cu, Zn, Mo, V, Ni, and Cr—in sediments and rocks enriched in organic matter has been reported by

Table 2. (Continued).

Sample	Core	Section	Interval	DEPTH-m	% SiO2	% Al2O3	% Fe2O3	% MgO	% CaO	% Na2O	% K2O	% TiO2	% P2O5	% MnO	ppm As	ppm B	ppm Ba	ppm Be	ppm Cd	ppm Co
10891075	89	1	75	958.75	34.50	8.67	5.03	2.12	22.20	.91	2.23	.79	.21	.82	<20	50	1,900	<3	<5	6
10892060	89	2	60 r	960.10	52.80	13.30	8.86	2.44	.66	1.51	3.85	1.32	.14	.03	<20	100	2,400	<3	<5	120
10892061	89	2	60 r	960.10	52.90	13.30	9.11	2.46	.67	1.48	3.86	1.32	.15	.03	90	340	3,200	3	20	150
10896130	89	6	130 r	966.80	58.60	13.90	8.10	2.98	.93	1.78	3.77	1.46	.21	.06	20	90	1,400	3	8	53
10903055	90	3	55 g	970.55	31.10	7.70	8.73	8.00	15.80	.84	2.10	.79	.11	1.15	<20	220	420	<3	8	24
10903062	90	3	62 b	970.62	59.00	14.60	6.97	2.94	.86	1.72	3.94	1.59	.17	.06	<20	120	1,200	<3	12	25
10911096	91	1	76 r	976.76	49.00	12.60	8.56	2.42	.86	1.38	3.52	1.22	.24	.05	90	80	2,400	3	17	130
10912103	91	2	103 g	978.53	56.70	13.80	11.00	2.76	.76	1.63	3.70	1.40	.20	.07	<20	90	2,100	<3	<5	14
10936083	93	6	83 b	998.33	55.80	13.50	7.48	3.43	2.73	1.52	3.64	1.18	.16	.28	30	110	5,100	3	<5	140
10936089	93	6	89	998.39	53.30	11.90	10.70	2.71	.78	1.38	3.22	1.06	.14	.07	60	330	4,200	3	11	180
10936092	93	6	92	998.42	60.50	13.20	8.26	2.87	.86	1.71	3.24	1.49	.16	.06	30	270	2,000	<3	19	64
10942026	94	2	26 g	1,000.76	62.40	12.60	8.50	2.73	.72	1.56	3.13	1.25	.12	.04	<20	80	1,100	<3	<5	13
10942035	94	2	35 b	1,000.85	57.30	12.50	9.20	3.43	1.39	1.51	2.97	1.22	.19	.23	<20	80	2,100	3	<5	9
10942036	94	2	35 b	1,000.85	52.40	12.80	8.86	2.82	2.18	1.49	3.05	1.15	.17	.07	50	110	3,400	3	9	73
10942104	94	2	104 r	1,001.54	52.10	12.60	9.02	2.84	2.21	1.42	3.03	1.14	.17	.06	30	110	3,400	<3	<5	53
10952120	95	2	120 g	1,010.70	51.00	11.10	8.78	2.67	8.26	1.35	2.74	1.08	.16	.20	<20	220	1,200	<3	7	16
10952127	95	2	127 b	1,010.77	58.30	13.80	7.73	3.01	1.40	1.52	3.39	1.31	.17	.04	<20	100	330	3	<5	15
10953038	95	3	38 r	1,011.38	43.60	10.80	9.66	2.33	1.09	1.31	2.71	.97	.30	.04	50	110	300	<3	33	170
10958000	95	8	0 b	1,014.55	57.40	12.40	10.40	2.94	3.02	1.61	2.94	1.28	.15	.06	<20	300	340	<3	51	22
10901021	96	1	21	1,017.21	60.70	13.10	8.12	2.81	.79	1.64	2.97	1.24	.16	.09	20	60	300	<3	<5	33
10961052	96	1	52 b	1,017.52	60.50	13.30	6.55	2.91	.82	1.59	3.15	1.16	.15	.03	<20	70	280	3	<5	49
10961063	96	1	63 g	1,017.63	63.40	13.10	6.46	2.88	.97	1.69	2.81	1.27	.24	.03	<20	80	320	<3	<5	51
10961070	96	1	70 g	1,017.70	61.20	12.30	6.68	2.91	2.62	1.52	2.84	1.18	.16	.11	<20	50	290	<3	9	10
10964024	96	4	24 b	1,021.74	59.90	11.50	8.05	2.50	.68	1.41	2.83	1.03	.17	.02	<20	90	360	3	<5	52
10964040	96	4	40	1,021.90	65.00	11.20	5.99	2.59	2.39	1.47	2.55	1.17	.16	.07	<20	50	310	<3	<5	15
10964047	96	4	47	1,021.97	45.80	7.53	8.31	2.85	13.50	.98	1.72	.72	1.02	.48	<20	50	310	<3	<5	8
10964048	96	4	47	1,021.97	45.80	7.46	8.54	2.83	13.70	1.01	1.71	.73	1.08	.50	<20	70	340	<3	<5	13
10973070	97	3	70 b	1,029.70	34.20	8.36	6.87	1.92	6.73	1.30	1.98	.71	.29	.16	50	50	240	<3	100	52
10973085	97	3	85 g	1,029.85	53.40	12.10	9.21	3.32	4.88	1.44	2.86	1.11	.15	.27	<20	80	380	<3	8	22
10974056	97	4	56 b	1,031.06	55.10	12.20	7.03	2.82	1.03	1.38	3.09	1.03	.25	.03	20	200	380	3	8	19
10974085	97	4	85 g	1,031.35	61.00	12.90	7.87	3.20	1.13	1.41	3.37	1.13	.44	.07	<20	90	350	<3	<5	20
10983050	98	3	50 b	1,038.50	48.60	10.60	8.25	2.53	.75	1.34	2.85	.95	.18	.05	50	190	370	<3	86	42
10983059	98	3	59 g	1,038.59	57.10	12.50	11.20	3.12	1.04	1.49	3.27	1.18	.14	.10	<20	80	340	<3	<5	20
10983128	98	3	128 b	1,039.28	52.70	11.80	8.68	2.75	.71	1.34	3.15	.98	.14	.06	20	100	380	<3	37	140
10983133	98	3	133 g	1,039.33	55.80	12.20	11.40	2.97	1.21	1.48	3.20	1.28	.16	.12	60	70	370	<3	<5	28
10983134	98	3	133 g	1,039.33	55.60	12.20	12.00	2.91	1.27	1.51	3.18	1.34	.17	.13	50	80	390	<3	<5	27
10992032	99	2	32 b	1,045.82	62.20	13.10	7.45	2.94	.72	1.44	3.46	1.11	.14	.03	<20	70	300	<3	<5	35
10992046	99	2	46 g	1,045.96	53.90	9.37	5.56	2.24	10.90	1.12	2.43	.89	.18	.62	<20	150	320	<3	6	15
10992060	99	2	60 g	1,046.10	17.00	3.95	3.00	1.25	38.50	.40	.92	.33	.08	2.33	<20	90	140	<3	27	9
10995067	99	5	67 b	1,050.67	56.90	11.70	10.10	2.91	.65	1.30	3.45	1.06	.18	.04	<20	130	360	4	<5	110
10995083	99	5	83 g	1,050.83	64.90	11.90	7.42	2.85	.76	1.37	3.20	1.06	.21	.04	<20	70	350	<3	<5	21
11001099	100	1	99 b	1,053.99	59.90	12.30	8.48	2.96	.90	1.42	3.56	1.28	.20	.05	20	240	400	<3	6	58
11001115	100	1	115 g	1,054.15	67.70	11.20	6.19	2.77	.68	1.32	2.97	1.03	.17	.04	20	70	370	<3	6	26
11001126	100	1	126	1,054.26	57.30	10.10	8.11	3.05	6.51	1.06	2.73	.87	.16	.33	<20	70	300	<3	<5	27
11003128	100	3	128	1,057.28	63.40	12.10	8.14	2.92	.61	1.20	3.53	1.15	.14	.04	30	100	540	3	<5	74
11003133	100	3	133 b	1,057.33	58.50	10.30	7.42	2.68	6.03	.99	2.73	.90	.12	.13	<20	160	380	<3	<5	20
11003134	100	3	133 b	1,057.33	58.80	10.30	7.39	2.67	6.07	1.06	2.78	.91	.12	.13	<20	40	320	<3	10	16
11003142	100	3	142 g	1,057.42	45.90	6.96	5.29	1.84	18.00	.96	1.86	.62	.24	1.07	<20	50	1,600	<3	<5	19
11011045	101	1	145 b	1,063.45	61.20	9.89	9.88	2.31	.55	1.11	2.93	.89	.12	.03	60	60	990	<3	8	76
11012004	101	2	4 b	1,063.54	66.50	9.80	6.25	2.58	2.95	1.18	2.59	.92	.12	.06	40	200	670	<3	24	25
11012016	101	2	16	1,063.66	52.30	7.24	3.63	1.72	15.20	.91	1.94	.61	.23	.53	<20	30	1,000	<3	<5	12
11012017	101	2	16	1,063.66	52.50	7.27	3.65	1.70	15.20	.87	1.95	.62	.24	.53	90	30	1,100	<3	6	13
11015034	101	5	34 r	1,068.34	64.60	10.40	9.96	2.85	.61	1.25	2.92	.98	.14	.07	<20	70	390	<3	<5	64
11023113	102	3	113 g	1,075.13	58.90	11.70	5.73	2.83	5.50	1.24	3.21	1.06	.16	.15	50	210	410	3	69	38
11023122	102	3	122 b	1,075.22	56.20	12.10	8.11	2.84	.80	1.29	3.29	1.03	.17	.05	30	270	430	3	20	100
11023137	102	3	137	1,075.37	47.10	7.79	3.36	1.88	18.10	.93	2.08	.64	.13	.62	<20	50	300	<3	10	12
11026003	102	6	3 r	1,078.53	65.40	10.50	9.12	2.96	.86	1.20	2.85	.93	.21	.22	<20	30	300	<3	7	12
11034029	103	4	29 b	1,084.79	61.40	10.50	6.78	2.78	3.71	1.32	3.07	1.27	.17	.09	<20	60	390	<3	12	60
11034035	103	4	35 g	1,084.85	56.00	7.44	4.49	2.31	12.60	.89	2.01	.63	.12	.65	<20	150	310	<3	32	17
11034131	103	4	131 b	1,085.81	58.40	9.37	7.38	2.98	6.31	1.09	2.63	1.08	.16	.19	<20	60	300	<3	<5	30
11034135	103	4	135 g	1,085.85	54.10	7.39	6.14	2.78	12.60	.71	1.82	.55	.10	.58	<20	50	260	<3	<5	11
11042142	104	2	142 g	1,087.92	61.90	10.60	7.03	2.87	3.30	1.14	3.08	.93	.13	.15	<20	50	300	<3	<5	23
11043006	104	3	6 b	1,088.06	60.00	9.45	7.15	2.43	3.80	1.21	2.84	1.07	.17	.21	50	170	460	3	<5	30
11043014	104	3	14	1,088.14	58.60	9.70	8.29	2.72	2.74	1.40	2.99	1.52	.26	.21	<20	230	630	<3	18	49
11043047	104	3	47 g	1,088.47	64.30	10.40	7.22	3.12	1.95	1.34	3.10	1.21	.16	.07	<20	60	430	<3	<5	45
11043054	104	3	54 g	1,088.54	68.90	9.88	6.54	3.30	.89	1.04	2.76	.85	.11	.64	<20	210	400	<3	27	20
11043056	104	3	54 g	1,088.54	68.60	9.82	6.49	3.28	.85	1.09	2.73	.84	.11	.48	<20	70	330	<3	<5	14
11053089	105	3	89 b	1,097.89	56.20	12.10	6.51	3.09	.93	1.27	3.31	1.05	.15	.08	50	90	380	<3	<5	13
11053140	105	3	140 g	1,098.40	62.50	12.30	7.32	3.17	.83	1.36	3.58	1.14	.18	.10	20	50	320	3	<5	16
11054010	105	4	10 b	1,098.60	54.60	11.20	7.45	2.78	4.39	1.41	3.40	1.20	.30	.16	20	60	400	<3	<5	25
11054031	105	4	31 g	1,098.81	62.80	11.90	7.52	3.25	.68	1.36	3.58	1.22	.17	.07	<20	40	320	<3	<5	11
11055000	105	5	0 r	1,100.00	65.50	10.30	7.67	3.32	1.67	1.10	3.09	.93	.16	.08	<20	190	340	<3	6	42
11055054	105	5	54	1,100.54	65.10	10.60	7.94	3.43	1.36	1.12	3.12	.93	.19	.08	<20	60	360	<3	38	21
11055093	105	5	93	1,100.93	64.30	11.00	8.91	3.39	.82	1.15	3.28	.97	.19	.09	<20	60	370	<3	24	26
11055094	105	5	93	1,100.93	64.70	11.00	8.93	3.38	.86	1.19	3.26	.99	.19	.09	<20	90	470	<3	<5	19
11055110	105	5	110	1,101.10	59.40	12.90	9.72	4.13	.77	1.23	3.74	1.05	.15	.07	<20	70	360	<3	30	32
11055139	105	5	139	1,101.39	62.00	11.40	10.30	3.42	.77	1.29	3.67	1.03	.14	.05	<20	90	360	<3	<5	30
11056004	105	6	4	1,101.54	62.20	10.40	12.00	3.23	.57	1.14	3.70	.89	.16	.08	<20	90	360	<3	94	31
11056015	105	6	15	1,101.65	58.40	11.90	10.60	3.50	2.32	1.31	3.58	1.03	.21	.23	<20	50	290	<3	<5	21
11056024	105	6	24	1,101.74	59.40	12.20	10.60	3.60	1.32	1.20	3.69	1.01	.18	.14	<20	80	380	<3	13	27
11058001	105	8	1	1,101.82	58.70	12.60	11.00	3.71	.84	1.43	3.65	1.11	.20	.08	<20	60	360	<3	<5	11
11058010	105	8	10	1,101.91	40.50	7.30	5.64	2.26	20.50	.74	2.09	.58	.11	1.29	<20	50	240	<3	9	15

many investigators (e.g., Wedepohl, 1964 and 1979; Brongersma-Sanders, 1965; Calvert and Price, 1970; Vine and Tourtelot, 1969 and 1970; Volkov and Fomina, 1974; Lange et al., 1978; Brongersma-Sanders, et al., 1980; Dean and Gardner, 1982). Comparison of concentrations of elements in other modern and ancient organic-carbon-rich sediments is discussed by Dean, Arthur, and Stow (this volume). The association of high trace-element concentrations with organic matter may be the result of concentration of these elements by organisms (bioconcentration), or by chemical sorption and precipitation. Marine plankton are known to concentrate trace elements, especially Pb, Ni, Cu, Zn, Mn, and Fe (Vinogradov, 1953; Goldberg, 1957; Boyle and Lynch, 1968; Martin and Knauer, 1973; Chester et al., 1978; Leinen and Stakes, 1979), and this suggests that bioconcentration may be an important mechanism for incorporation of certain trace elements in marine sediments rich in organic matter. The great effectiveness of adsorption of trace metals by clay minerals and organic

Table 2. (Continued).

ppm Cr	ppm Cu	ppm Ga	ppm Li	ppm Mo	ppm Ni	ppm Pb	ppm Sc	ppm Sr	ppm Th	ppm U	ppm V	ppm Zn	ppm Zr	ppm Y	ppm La	ppm Ce	ppm Nd	ppm Dy	ppm Yb	% $CaCO_3$
79	40	<20	19	<5	37	<20	13	450	<10	<100	120	66	110	36	25	80	<50	6	3	39.6
290	220	<20	31	8	190	<20	20	190	<10	<100	570	260	170	22	27	50	<50	<5	4	1.2
380	310	40	47	9	260	<20	23	240	<10	<100	740	300	280	31	40	60	<50	<5	7	1.2
170	85	80	47	7	97	70	36	250	70	500	260	170	230	37	46	150	110	40	8	1.7
58	57	40	20	<5	56	<20	11	210	30	<100	150	96	<10	26	28	60	70	9	5	28.2
150	84	80	57	<5	80	<20	30	240	10	100	300	130	330	38	39	110	70	26	6	1.5
180	170	<20	38	77	490	<20	17	180	<10	<100	1,400	1,100	180	40	28	70	60	21	7	1.5
97	100	<20	32	<5	61	<20	18	220	<10	<100	190	110	180	25	28	50	50	16	4	1.4
140	70	180	52	11	320	120	52	270	70	900	160	140	200	54	73	260	70	25	7	4.9
250	250	50	35	5	300	20	29	230	20	100	650	260	70	34	39	110	<50	35	7	1.4
160	130	80	46	<5	120	<20	29	260	20	<100	300	160	280	40	53	170	<50	35	7	1.5
82	100	<20	30	<5	37	<20	21	190	<10	<100	180	95	160	23	39	110	50	9	3	1.3
120	37	<20	24	<5	67	<20	20	300	<10	<100	140	160	230	35	31	<30	<50	<5	<2	2.5
290	230	110	61	21	170	70	36	240	130	700	590	430	200	51	62	230	260	98	10	3.9
220	210	<20	39	9	130	<20	19	230	<10	<100	500	410	180	28	33	50	<50	<5	2	3.9
64	32	50	28	<5	47	<20	23	290	10	100	160	63	30	34	45	130	80	6	3	14.7
100	71	<20	54	6	50	<20	21	210	10	<100	390	300	230	28	30	50	60	20	4	2.5
200	220	30	50	91	650	<20	23	180	<10	<100	2,100	1,300	250	61	42	130	130	42	8	1.9
92	84	70	40	<5	65	<20	28	270	40	<100	240	88	250	30	27	60	<50	66	6	5.4
130	97	50	43	18	85	90	24	160	<10	100	300	140	200	33	32	100	<50	<5	9	1.4
290	180	<20	31	<5	72	50	22	160	10	<100	480	220	170	29	35	80	<50	12	4	1.5
79	100	<20	35	<5	87	<20	25	200	<10	<100	180	130	200	30	32	60	<50	9	3	1.7
79	110	<20	26	<5	37	<20	19	170	<10	<100	160	150	180	31	26	50	50	8	4	4.7
370	180	<20	42	<5	93	<20	21	170	<10	<100	570	230	170	28	34	50	<50	9	5	1.2
85	95	<20	31	<5	35	<20	17	160	<10	<100	180	93	150	29	30	60	<50	12	3	4.3
46	37	<20	28	<5	28	<20	13	260	<10	<100	130	56	120	130	72	190	140	38	7	24.1
59	41	30	25	<5	52	<20	21	290	10	<100	140	78	60	160	100	250	150	37	8	24.5
230	380	<20	26	170	310	20	16	210	<10	<100	2,400	5,200	80	62	36	80	60	14	10	12.0
110	92	50	61	6	53	<20	25	210	<10	<100	300	150	260	41	46	80	50	19	7	8.7
560	230	<20	54	<5	72	<20	17	190	20	<100	590	290	190	57	39	50	110	28	7	1.8
87	74	<20	48	<5	39	<20	23	160	20	<100	260	100	160	52	44	120	90	19	5	2.0
110	260	<20	53	53	310	<20	17	140	<10	<100	2,200	4,100	170	38	24	50	<50	<5	8	1.3
61	71	<20	48	<5	37	<20	19	150	<10	<100	150	75	160	21	36	70	<50	<5	2	1.9
210	210	70	61	65	300	<20	24	170	<10	<100	1,300	2,000	250	43	36	130	70	39	10	1.3
83	77	<20	47	11	73	<20	18	170	<10	<100	250	370	180	21	29	40	<50	15	3	2.2
70	83	<20	49	11	72	<20	17	180	10	<100	270	250	160	16	28	50	<50	16	2	2.3
130	92	<20	28	<5	49	<20	23	150	<10	<100	210	130	140	23	30	80	<50	10	3	1.3
68	86	50	29	<5	43	<20	18	260	<10	<100	130	65	<10	33	36	90	60	<5	3	19.5
28	23	50	16	<5	20	20	5	200	10	<100	50	35	70	30	17	110	<50	30	3	68.7
540	180	170	50	20	130	90	39	150	30	900	320	240	180	55	64	250	<50	<5	<2	1.2
66	82	<20	35	<5	56	<20	20	150	20	<100	140	72	160	28	32	80	70	16	2	1.4
220	120	40	42	<5	91	20	23	170	10	<100	260	120	90	33	36	80	60	21	6	1.6
96	130	100	48	9	59	70	31	160	80	700	170	96	170	44	61	220	90	56	7	1.2
85	64	120	41	15	67	50	28	190	50	500	130	83	140	46	52	170	80	30	6	11.6
180	130	130	47	6	110	100	34	150	80	800	220	110	200	39	54	190	120	61	6	1.1
51	67	<20	22	<5	37	<20	22	210	20	<100	140	75	150	23	27	60	<50	<5	<2	10.8
69	67	<20	28	<5	35	90	14	180	10	900	110	61	140	21	20	40	<50	11	3	10.8
36	98	<20	23	<5	36	<20	12	310	<10	100	66	61	80	31	32	90	<50	<5	3	32.1
420	120	<20	35	7	120	20	15	120	<10	<100	230	130	150	21	20	50	<50	<5	3	1.0
93	89	100	44	<5	53	<20	20	200	30	<100	170	85	200	28	37	110	<50	14	3	5.3
45	57	<20	21	<5	34	<20	12	300	<10	<100	100	110	60	32	24	70	<50	11	3	27.1
47	62	50	31	6	34	40	11	300	30	<100	87	68	100	37	30	100	70	17	3	27.1
86	49	120	37	7	90	<20	32	140	50	700	120	92	170	37	56	210	<50	13	4	1.1
110	100	50	52	<5	53	30	20	240	40	100	200	93	240	32	29	130	<50	15	5	9.8
270	170	50	58	18	200	<20	28	170	40	<100	430	130	250	33	33	70	<50	9	6	1.4
50	65	80	32	<5	29	<20	20	430	<10	<100	100	70	180	34	34	80	<50	19	4	32.3
59	32	<20	25	<5	40	20	17	130	<10	<100	97	62	160	28	20	40	<50	<5	<2	1.5
80	81	50	45	<5	110	<20	27	210	<10	<100	200	140	270	27	25	60	<50	22	7	6.6
62	60	40	47	<5	50	<20	11	300	20	200	120	77	140	26	22	90	<50	25	<2	22.5
55	77	20	29	<5	54	<20	19	210	<10	100	130	78	140	19	20	50	<50	<5	<2	11.3
37	48	20	26	<5	33	<20	15	290	10	<100	94	79	30	23	28	60	<50	<5	2	22.5
64	52	<20	31	<5	44	<20	17	140	<10	<100	120	90	110	23	24	60	<50	11	3	5.9
66	76	30	43	<5	100	<20	13	200	50	200	260	140	180	21	29	60	170	36	6	6.8
160	110	50	57	11	150	<20	28	220	10	200	360	100	290	41	41	130	<50	8	4	4.9
75	76	30	37	<5	83	20	27	180	20	<100	180	110	120	29	26	70	<50	15	3	3.5
83	76	60	54	5	58	50	23	130	30	<100	150	93	190	29	33	70	50	18	4	1.6
47	63	<20	39	<5	36	<20	17	110	<10	<100	100	73	120	16	25	50	<50	<5	<2	1.5
99	140	<20	59	10	54	<20	17	140	<10	<100	200	140	170	21	22	<30	50	11	4	1.7
69	76	<20	45	12	46	80	20	120	40	<100	130	83	170	26	29	80	70	20	3	1.5
74	100	30	51	35	87	20	24	210	<10	<100	350	170	180	30	31	100	<50	<5	4	7.8
80	50	<20	41	6	43	<20	15	120	<10	<100	130	75	170	19	19	30	<50	7	2	1.2
56	67	40	44	<5	75	<20	25	160	10	<100	110	82	20	27	32	80	<50	14	3	3.0
65	68	60	56	<5	65	<20	20	150	<10	<100	120	120	240	35	39	120	60	<5	5	2.4
52	63	50	50	<5	71	<20	22	140	30	200	130	110	240	37	39	110	<50	12	6	1.5
79	57	30	45	<5	71	<20	23	380	10	<100	150	120	130	31	46	130	<50	13	3	1.5
99	210	70	60	<5	97	20	27	160	<10	<100	160	140	260	35	33	120	80	21	4	1.4
160	69	30	32	<5	93	<20	23	150	<10	<100	300	110	120	27	33	90	<50	<5	3	1.4
210	56	30	42	<5	82	<20	24	130	<10	<100	300	110	230	31	55	180	90	22	4	1.0
70	42	<20	27	<5	78	<20	19	130	<10	<100	82	82	120	30	27	70	<50	<5	3	4.1
63	63	50	48	<5	72	<20	24	140	<10	<100	130	100	290	36	33	120	<50	16	5	2.4
58	60	<20	36	<5	75	<20	18	170	<10	<100	100	83	180	24	12	<30	<50	25	5	1.5
37	130	90	30	<5	47	<20	15	150	<10	<100	75	49	150	27	33	70	<50	7	3	36.6

matter, and coprecipitation of trace metals, paticularly as sulfide minerals suggest that these processes also may play an important role in the removal of trace metals from seawater (Tourtelot, 1964 and 1979; Holland, 1979). Unfortunately, it is not possible to separate the effects of bioconcentration and chemical processes, especially in anoxic, organic-carbon-rich strata.

If thin beds of black shale are interstratified with other lithologies, these beds may become sinks for elements mobilized and transported in pore waters during compaction (Berner, 1969; 1975). We believe that our data (Table 2; Fig. 2) illustrate the importance of interbedded more-reduced and less-reduced strata on the migration and accumulation of trace elements, and on the relative mobility of different elements under reducing conditions. In Figure 9 we have plotted carbonate-free concentrations of Fe_2O_3, Fe:Al, MnO, Ba, Co, Ni, Pb, Cr, Cu, Cd, Mo, V, and Zn in black-shale samples along with histograms of percent black-shale beds and mass accumulation rate (MAR) of organic carbon in

Table 3. Chemical analyses of samples from Leg 75, Hole 530B.

Sample	Core	Section	Interval	DEPTH m	% SiO2	% Al2O3	% Fe2O3	% MgO	% CaO	% Na2O	% K2O	% TiO2	% P2O5	% MnO	ppm As	ppm B	ppm Ba	ppm Be	ppm Cd	ppm Co
20011055	1	1	55	.55	14.4	4.6	1.75	1.34	38.90	.95	.17	.16	.07	<.02	<20	50	500	<3	<5	5
20012047	1	2	47	1.97	28.0	6.5	3.19	2.21	23.60	3.01	.90	.29	.14	<.02	<20	120	1,100	<3	<5	9
20022092	2	2	92	4.82	31.8	7.9	3.89	1.94	20.50	3.07	1.03	.37	.15	<.02	<20	140	810	<3	18	6
20022134	2	2	134	5.24	40.3	10.8	4.90	2.63	9.73	3.49	1.62	.53	.24	.02	<20	150	750	<3	<5	9
20023031	2	3	31	5.71	37.6	9.4	4.39	2.30	13.20	3.34	1.46	.46	.23	.02	<20	90	740	<3	<5	6
20032053	3	2	53	8.83	22.4	6.5	2.54	1.68	30.50	2.23	.81	.25	.10	.03	<20	130	780	<3	<5	8
20033125	3	3	125	11.05	45.1	9.6	4.98	2.40	7.95	3.73	1.78	.50	.18	.03	<20	160	1,200	<3	9	10
20041114	4	1	114	12.34	47.0	11.2	4.99	2.44	8.59	3.05	2.02	.58	.27	.03	<20	130	600	<3	<5	8
20043010	4	3	10	14.30	23.1	5.9	2.60	1.58	30.60	1.54	.34	.24	.13	.03	<20	90	790	<3	<5	8
20063034	6	3	34	23.34	12.5	3.9	1.61	1.17	41.50	1.23	.39	.14	.10	.02	<20	90	460	<3	17	10
20072070	7	2	70	25.60	47.3	10.2	4.81	2.18	11.00	2.63	1.91	.59	.24	.04	<20	110	430	<3	<5	9
20073030	7	3	30	26.70	35.2	7.0	3.40	1.69	19.90	2.66	1.13	.33	.16	<.02	20	180	630	<3	<5	11
20082065	8	2	65	29.95	54.3	7.4	3.63	1.56	5.24	3.46	1.52	.33	.13	.02	<20	210	920	<3	6	8
20093127	9	3	127	36.47	39.4	9.5	4.49	2.13	14.40	2.56	1.60	.45	.18	.03	<20	130	870	<3	<5	9
20103031	10	3	31	39.91	49.9	11.0	5.15	2.29	5.75	3.06	2.19	.54	.22	.03	20	260	880	<3	5	10
20103107	10	3	107	40.67	49.6	10.3	5.05	2.25	6.41	3.19	2.05	.50	.22	.03	<20	160	940	<3	<5	12
20112054	11	2	54	43.04	51.2	12.0	5.69	2.57	4.29	2.95	2.42	.62	.34	.04	<20	130	620	<3	<5	11
20122129	12	2	129	48.19	51.2	9.1	5.32	2.72	5.64	2.88	2.10	.45	.49	.03	<20	190	630	<3	<5	13
20143028	14	3	28	57.48	24.4	5.6	2.59	1.67	31.80	1.47	.73	.26	.11	.03	<20	90	550	<3	13	<5
20162066	16	2	66	65.16	60.2	9.0	4.42	2.21	1.09	3.15	2.00	.45	.15	.02	<20	120	2,000	<3	9	7
20172042	17	2	42	69.32	63.1	8.8	4.18	1.99	.72	3.28	1.86	.43	.12	.02	<20	130	810	<3	<5	10
20182045	18	2	45	73.75	61.0	9.0	4.59	2.09	.64	3.14	1.98	.43	.14	<.02	40	280	810	<3	18	13
20202105	20	2	105	83.15	53.9	8.9	4.30	2.27	6.78	2.86	1.98	.44	.12	.03	40	130	810	<3	6	14
20223084	22	3	84	91.84	51.9	8.7	4.30	2.15	7.60	3.11	1.85	.41	.13	.03	<20	220	900	<3	6	11
20232071	23	2	71	94.61	63.0	8.6	4.27	2.05	.67	3.18	1.84	.43	.11	<.02	<20	150	890	<3	<5	10
20252105	25	2	105	102.35	54.5	10.1	4.80	2.48	5.56	2.49	2.23	.47	.11	.03	<20	130	980	<3	29	13
20262100	26	2	100	105.30	59.8	11.0	5.69	2.49	.71	2.88	2.50	.54	.09	.04	<20	170	1,300	<3	9	17
20271066	27	1	66	107.86	37.8	6.1	2.89	2.81	21.30	1.81	1.14	.27	.11	<.02	<20	120	950	<3	<5	11
20271067	27	1	66	107.86	37.5	6.1	2.84	2.82	21.10	1.98	1.05	.27	.11	<.02	<20	90	930	<3	<5	8
20272052	27	2	52	109.22	57.6	11.0	5.46	2.50	1.54	2.85	2.42	.53	.12	.03	30	250	1,600	<3	5	14
20392034	39	2	34	151.04	24.8	6.2	2.78	1.75	31.80	1.35	.68	.27	.10	<.02	<20	120	510	<3	<5	6
20413045	41	3	45	158.05	27.7	8.0	3.66	2.09	27.10	1.69	1.12	.35	.11	<.02	<20	100	590	<3	<5	12
20443051	44	3	51	165.51	33.0	9.5	4.25	2.33	22.80	1.47	1.72	.40	.10	<.02	40	120	500	<3	<5	17
20443052	44	3	51	165.51	33.2	9.6	4.32	2.35	22.80	1.46	1.78	.40	.11	<.02	<20	120	520	<3	<5	16
20443071	44	3	71	165.71	46.3	13.0	6.28	3.15	8.94	2.06	2.85	.60	.13	.02	<20	150	750	<3	12	27

each core for Cores 86 through 105. Except for Mn, the elements plotted in Figure 9 are mostly concentrated in a zone between about 950 and 1050 m sub-bottom within Unit 8. Maximum concentrations are not all at the same depth, and this suggests that some elements may have been more mobile than others during diagenesis. Another possibility to explain systematic differences in element composition of black-shale beds through time is that the chemical composition of the organic matter that accumulated in the black shale beds changed with time, but this is unlikely; organic geochemical analyses do not indicate that there are any systematic long-term changes in amount or composition of organic matter in black-shale beds from bottom to top of Unit 8 (see Brassell et al., and Meyers, Brassell, and Huc, both this volume).

Manganese is the only element that is enriched in rocks below the black-shale maximum (Cores 97 to 98; 1026 to 1044 m). Figure 7 and Table 6 show that the concentration of manganese is significantly enriched in red and green claystone beds relative to black shale beds. Wedepohl (1964) and Vine and Tourtelot (1970) also noted that concentrations of manganese typically are lower in shales containing little organic matter. Some anoxic sediments may be relatively enriched in manganese due to local precipitation of Mn-rich carbonate phases (for example, Suess, 1979 and Pederson and Price, 1982). That the few high manganese concentrations in black-shale beds at Site 530 probably are associated with carbonates is indicated by a high positive correlation between concentrations of Mn and Ca ($r = 0.85$). The carbonate content of the black shales is highest in the lower part of the section (Fig. 2) which explains the higher concentration of manganese there. Any manganese that was not coprecipitated with carbonate quickly diffused out of the reduced sediment. For the same reason, manganese also is concentrated in red and green claystone at the contact between Unit 8 and the overlying red claystone of Unit 7 (Fig. 2).

The concentrations of Fe_2O_3 and Ba are not significantly higher in black, green, or red lithologies relative to each other, but they are higher in all three different-colored lithologies above the black-shale maximum than in any lithology below the black-shale maximum, or in any other lithology in Hole 530A. This difference is greatest for barium, which is as much as an order of magnitude higher in the upper part of the section (Fig. 9). Barium probably also was concentrated in organic matter but diffused out of the black shale beds and became concentrated, probably as barite, in the upper part of Unit 8, with a maximum concentration about 60 m above the black-shale maximum. Diagenetic concentrations of barium as barite in association with organic-carbon-rich strata have been described from many DSDP sites (see review by Dean and Schreiber, 1978).

Of the remaining trace elements that are enriched in Unit 8 (Fig. 9), Cd, Zn, V, Mo, and Cu have maximum concentrations that correspond to the black-shale maximum in Cores 97 and 98, indicating that they have not migrated far from their organic source. These elements also are among the ones most commonly reported to be concentrated in black shales from other areas. Concentrations of these elements are highly correlated with each other ($r > 0.85$ for Cd, Zn, V, and Mo; ($r > 0.65$ for Cu). Concentrations of Cr and Cu have maxima that correspond to the black shale maximum (Fig. 9), but also have maxima in the upper part of Unit 8 where black shale beds comprise less than 10% of the section. These second maxima above and about the same magnitude as the maxima for Cores 97 and 98 suggest that Cu and Cr may have been more mobile during diagenesis than Cd, Zn, V, or Mo. Maximum concentrations of Co, Ni, and Pb do not correspond to the black-shale maximum, and

Table 3. (Continued).

ppm Cr	ppm Cu	ppm Ga	ppm Li	ppm Mo	ppm Ni	ppm Pb	ppm Sc	ppm Sr	ppm Th	ppm U	ppm V	ppm Zn	ppm Zr	ppm Y	ppm La	ppm Ce	ppm Nd	ppm Dy	ppm Yb	% CaCO3
51	58	<20	30	<5	37	<20	<5	1,100	<10	<100	50	35	20	7	<5	<30	<50	<5	<2	69.5
82	59	30	46	8	52	<20	12	720	10	100	73	73	50	16	15	30	<50	9	<2	42.1
92	54	40	45	6	47	<20	15	520	10	<100	67	68	60	17	14	50	<50	12	3	36.6
120	56	<20	73	9	69	<20	15	360	<10	<100	90	91	80	20	22	30	<50	<5	<2	17.4
120	41	<20	54	13	79	<20	10	360	<10	900	71	64	90	19	12	30	<50	<5	<2	23.6
66	59	60	54	<5	47	<20	11	1,100	20	<100	68	63	<10	17	22	40	50	7	<2	54.5
150	68	60	70	38	80	<20	15	350	<10	<100	110	110	170	31	25	70	50	15	4	14.2
140	39	<20	71	<5	41	<20	13	350	<10	<100	100	73	120	23	17	<30	<50	15	4	15.3
65	65	40	39	5	38	<20	9	980	20	100	66	90	40	18	7	30	60	19	2	54.6
49	45	100	44	<5	28	20	13	1,800	20	200	59	31	40	14	14	80	<50	<5	<2	74.1
130	24	<20	40	8	35	<20	15	350	<10	<100	92	97	90	23	17	40	<50	<5	2	19.6
93	35	<20	36	<5	29	<20	17	650	30	<100	79	70	70	17	8	30	<50	<5	<2	35.5
71	59	20	34	6	49	<20	14	210	30	<100	80	82	60	12	10	30	90	18	2	9.4
130	59	<20	59	7	44	<20	18	580	10	<100	95	110	20	23	27	40	<50	<5	3	25.7
150	55	40	77	9	61	<20	21	270	20	100	100	87	<10	26	27	60	<50	5	4	10.3
140	54	30	56	8	68	<20	19	280	20	<100	100	110	30	26	27	70	<50	11	2	11.4
150	36	<20	52	8	52	<20	17	180	<10	<100	92	97	80	26	22	50	<50	<5	2	7.7
150	42	30	53	6	47	<20	17	240	<10	<100	98	90	80	20	21	40	<50	<5	<2	10.1
72	43	<20	39	<5	33	<20	7	940	<10	<100	61	60	50	13	6	<30	<50	18	<2	56.8
140	41	<20	48	22	52	20	11	120	<10	<100	79	79	80	17	14	<30	<50	<5	2	1.9
110	44	30	39	12	49	<20	14	87	20	<100	76	84	30	19	18	50	<50	11	2	1.3
170	78	60	71	31	75	<20	10	100	30	200	120	100	110	29	31	70	<50	11	6	1.1
120	86	60	66	<5	73	50	17	290	60	200	100	110	60	24	26	70	120	74	6	12.1
110	69	20	64	10	68	<20	18	290	10	<100	85	89	<10	18	22	50	<50	<5	3	13.6
120	53	50	64	23	58	<20	16	99	<10	<100	99	95	120	21	21	50	<50	<5	4	1.2
120	58	<20	69	<5	58	<20	13	230	20	<100	110	95	90	15	15	<30	<50	16	2	9.9
150	71	60	81	11	76	<20	21	110	<10	<100	130	130	150	23	28	50	<50	6	4	1.3
72	41	30	29	<5	38	<20	17	720	<10	100	66	70	50	14	6	40	<50	7	<2	38.0
84	53	<20	39	5	45	<20	7	720	<10	<100	57	60	40	10	10	<30	<50	<5	<2	37.7
160	79	20	83	6	74	<20	21	130	20	<100	130	120	<10	25	29	60	<50	17	3	2.7
77	28	50	48	<5	30	<20	13	1,100	20	100	65	47	<10	15	23	40	<50	<5	<2	56.8
91	47	<20	54	<5	59	<20	17	1,000	10	<100	100	91	<10	24	29	50	<50	10	2	48.4
98	46	30	52	<5	68	20	18	820	20	<100	100	110	10	25	30	60	<50	5	2	40.7
100	47	<20	50	<5	69	<20	16	800	20	<100	98	110	<10	23	27	60	<50	7	2	40.7
170	86	50	100	<5	83	110	24	400	30	<100	160	150	170	32	35	110	50	21	5	16.0

this suggests that these elements were among the most mobile during diagenesis and less affected by solubility, diffusion, and sulfide scavenging.

Geochemistry of Red Claystone above Basalt, Hole 530A

Sediments enriched in certain trace elements (especially Fe, Mn, B, Ba, As, Cd, V, Cu, Ni, Co, Cr, and Zn) by hydrothermal solutions have been reported in association with active crustal-spreading centers such as the East Pacific Rise and Galapagos Rift (Boström and Peterson, 1969; Boström et al., 1969; Boström, 1970; Dymond et al., 1973; Sayles and Bischoff, 1973; Sayles et al., 1975; Heath and Dymond, 1977; Corliss et al., 1979; Edmond et al., 1979; Spiess et al., 1980), and the Mid-Atlantic Ridge (Horwitz and Cronan, 1976; Rona, 1976; Rona et al., 1976; Varentsov, 1979). Enrichment of elements by hydrothermal solutions in sediments not associated with active spreading centers has been reported from the Philippine Basin (Bonatti et al., 1979) and in the northeast-Pacific manganese-nodule province (Bischoff and Rosenbauer, 1977). Because of the close proximity of Site 530 to the volcanically constructed Walvis Ridge, we thought that the oldest strata at that site also may be enriched in certain elements by hydrothermal activity. In order to test for hydrothermal enrichment, we collected 11 samples of red claystone of Cenomanian age from lithologic Unit 8 over a stratigraphic interval of 180 cm above basalt basement in Hole 530A.

Summary statistics of element concentrations in the 11 red claystone samples are given in Table 7, and plotted versus depth in Figure 10. The average concentration of each element in 12 samples of red claystone in lithologic Unit 8 (Table 6), not including the 11 samples within the 180-cm interval above basement, is shown by an arrow on the plot of that element in Figure 10. Figure 10 shows that concentrations of many elements tend to increase below about 1101 m, but few elements are enriched significantly relative to their concentrations in average red claystone in lithologic Unit 8 (arrows in Fig. 10). Certainly there are no large enrichments in any elements such as Fe, Mn, Ba, and B that are characteristic of sediments and rocks altered by hydrothermal solutions (Boström et al., 1969; Heath and Dymond, 1977; Bischoff and Rosenbauer, 1977).

Another way of detecting an influence by hydrothermal solutions is to examine the relative proportions of certain diagnostic hydrothermal- and nonhydrothermal-indicator elements. Figure 11 shows the relative proportions of Al, Fe, and Mn in the basal red claystone samples from Hole 530A. Fields showing the relative proportions of these elements in surface sediment from the South Atlantic Ocean (Boström et al., 1972), and in Pacific pelagic sediment, Bauer Basin sediment, and East Pacific Rise sediment (Bischoff and Rosenbauer, 1977) also are plotted in Figure 11 for comparison. The composition of red claystone above basalt in Hole 530A is slightly enriched in iron relative to South Atlantic surface sediment and Pacific pelagic sediment, but different from metalliferous, hydrothermal-enriched sediment from either the Bauer Deep or the East Pacific Rise.

The curves in Figure 12 were used by Boström (1970) to illustrate mixing of metalliferous sediments from the East Pacific Rise with either average oceanic basalt or average continental crust. Figures 11 and 12 show that the red claystone from Hole 530A and South Atlantic surface sediment are enriched in Al and depleted in Fe and Mn relative to metalliferous sediment from the East Pacific Rise.

All of the above considerations of the geochemistry of the strata above basalt at Site 530 indicate that there has been little or no enrichment of elements from metal-

Table 4A. Chemical analyses of samples from Leg 75, Hole 532.

Sample	Core	Section	Interval	DEPTH m	% SiO2	% Al2O3	% Fe2O3	% MgO	% CaO	% Na2O	% K2O	% TiO2	% P2O5	% MnO	ppm As	ppm B	ppm Ba	ppm Be	ppm Cd	ppm Co
30012015	1	2	15	1.65	12.7	4.0	1.86	1.38	36.40	1.77	.52	.17	.11	<.02	<20	60	400	<3	<5	6
30022115	2	2	115	6.65	21.5	6.9	3.58	1.75	28.50	1.89	.96	.30	.12	<.02	<20	100	520	<3	<5	<5
30032045	3	2	45	10.35	11.5	3.3	1.34	1.19	41.90	.78	.10	.12	.09	<.02	<20	50	700	<3	<5	<5
30043113	4	3	113	16.93	25.5	8.0	3.90	2.02	24.10	2.04	1.12	.36	.15	<.02	<20	120	830	<3	<5	5
30052095	5	2	95	19.65	24.8	6.3	2.92	1.78	25.00	2.06	.85	.26	.11	<.02	30	110	840	<3	<5	<5
30063058	6	3	58	25.18	20.5	5.9	2.90	1.65	30.30	1.83	.93	.24	.14	<.02	<20	110	680	<3	15	10
30071079	7	1	79	26.79	34.7	4.8	2.46	1.46	23.30	2.73	.90	.22	.11	<.02	20	90	840	<3	<5	7
30082090	8	2	90	32.80	34.4	6.9	3.37	1.82	21.50	2.04	1.11	.34	.15	<.02	<20	170	710	<3	5	9
30093115	9	3	115	38.95	20.4	5.0	2.44	1.38	34.80	1.41	.77	.21	.07	<.02	<20	50	540	<3	<5	6
30102046	10	2	46	41.16	22.4	5.5	2.42	1.46	32.60	1.37	.76	.24	.08	<.02	<20	50	610	<3	<5	<5
30102047	10	2	46	41.16	22.2	5.6	2.41	1.52	32.40	1.52	.86	.24	.08	<.02	60	80	690	<3	<5	20
30103069	10	3	69	42.89	25.2	6.5	3.23	1.73	27.20	1.70	.79	.31	.11	<.02	<20	70	850	<3	<5	<5
30113085	11	3	85	47.45	19.4	4.3	2.12	1.31	34.60	1.58	.66	.18	.10	<.02	<20	80	560	<3	<5	<5
30122085	12	2	85	50.35	35.2	7.3	3.71	2.01	19.20	2.11	1.28	.35	.10	<.02	<20	110	890	<3	14	7
30131115	13	1	115	53.55	42.0	6.5	3.35	1.92	16.30	2.37	1.33	.32	.09	<.02	<20	110	860	<3	<5	<5
30131116	13	1	115	53.55	42.3	6.4	3.35	1.88	16.30	2.30	1.35	.33	.09	<.02	40	90	830	<3	<5	<5
30143031	14	3	31	60.11	33.5	3.3	1.68	1.11	27.30	1.99	.50	.14	.07	<.02	<20	130	750	<3	13	6
30143032	14	3	31	60.11	33.7	3.3	1.68	1.05	27.50	1.58	.49	.14	.07	<.02	<20	120	670	<3	<5	<5
30152060	15	2	60	63.30	38.4	9.6	4.71	2.27	12.30	2.35	1.88	.46	.12	<.02	110	120	990	<3	17	9
30161120	16	1	120	66.80	30.1	4.6	2.17	1.29	28.10	1.76	.72	.19	.08	<.02	<20	70	800	<3	<5	<5
30173076	17	3	76	73.76	26.5	6.3	3.10	1.62	28.10	1.60	.91	.27	.10	<.02	<20	150	750	<3	<5	7
30203105	20	3	105	87.25	38.0	6.2	2.97	1.48	19.50	2.35	1.16	.27	.08	<.02	30	90	1,100	<3	<5	<5
30212001	21	2	1	89.11	42.8	10.3	4.85	2.03	9.17	2.59	2.11	.47	.12	<.02	<20	120	2,000	<3	<5	12
30222070	22	2	70	94.20	34.7	5.8	2.87	3.13	21.90	1.93	1.00	.27	.08	<.02	<20	60	340	<3	<5	<5
30232065	23	2	65	98.55	26.7	4.7	2.26	1.75	30.00	1.55	.66	.20	.07	<.02	<20	120	330	<3	<5	7
30251054	25	1	54	105.74	44.2	10.9	5.74	2.28	7.32	2.36	2.35	.57	.17	<.02	<20	240	600	<3	<5	12
30272123	27	2	123	116.73	44.8	9.3	6.08	3.13	15.80	1.63	2.27	1.09	.19	.09	20	120	550	<3	<5	8
30292054	29	2	54	129.47	26.4	7.0	3.46	1.69	27.10	1.60	1.06	.32	.13	<.02	<20	70	470	<3	<5	7
30312057	31	2	57	129.95	41.3	10.8	5.66	2.29	9.70	2.10	2.34	.55	.21	.02	<20	250	680	<3	6	10
30312105	31	2	105	131.94	29.2	7.9	4.01	1.73	24.50	1.60	1.20	.39	.16	<.02	20	110	620	<3	<5	13
30321014	32	1	14	134.96	41.0	11.7	6.36	2.53	7.25	2.15	2.53	.60	.21	<.02	<20	150	720	<3	<5	8
30323016	32	3	16	140.44	23.5	6.4	2.80	3.22	29.70	1.29	1.01	.27	.11	<.02	<20	60	570	<3	<5	5
30341124	34	1	124	143.99	23.5	5.9	3.01	1.90	31.20	1.31	.90	.27	.11	<.02	<20	160	690	<3	16	7
30351139	35	1	139	147.70	32.4	9.3	4.75	2.00	20.60	1.68	1.68	.46	.12	<.02	30	120	690	<3	<5	13
30361110	36	1	110	155.71	22.4	5.8	3.17	1.87	31.70	1.25	.67	.25	.15	<.02	<20	50	540	<3	<5	8
30382041	38	2	41	164.90	34.5	10.1	5.30	1.95	17.40	1.76	1.99	.50	.16	<.02	<20	100	590	<3	<5	10
30403110	40	3	110	167.35	25.0	7.0	3.55	1.62	29.20	1.38	.92	.32	.10	<.02	<20	90	580	<3	<5	5
30412065	41	2	65	168.02	25.2	6.9	3.43	1.81	29.80	1.34	1.05	.31	.11	<.02	20	170	730	<3	13	11
30412132	41	2	132	172.55	33.7	9.6	4.66	2.07	19.60	1.64	1.81	.45	.15	<.02	30	130	690	<3	<5	10
30422145	42	2	145	174.70	32.6	9.0	4.53	1.97	21.20	1.54	1.68	.44	.16	<.02	<20	70	600	<3	<5	<5
30431070	43	1	70	181.81	29.9	7.9	3.70	1.73	24.50	1.49	1.34	.36	.15	<.02	50	90	600	<3	6	<5
30443041	44	3	41	184.75	32.2	9.4	4.72	1.94	19.20	1.67	1.71	.44	.14	<.02	<20	110	670	<3	7	5
30452045	45	2	45	193.31	15.6	4.6	2.69	3.93	35.60	.78	.41	.18	.11	<.02	<20	60	750	<3	<5	7
30472061	47	2	61	198.54	22.7	6.9	3.28	1.60	31.70	1.20	.99	.32	.12	<.02	<20	60	530	<3	<5	5
30482144	48	2	144	198.65	33.4	9.7	5.33	1.99	19.50	1.60	1.87	.49	.16	<.02	60	220	870	3	99	14
30483005	48	3	5	198.65	31.5	9.2	4.79	1.93	21.80	1.57	1.62	.46	.15	<.02	<20	120	790	<3	11	10
30483006	48	3	5	201.96	31.5	9.2	4.90	1.98	21.50	1.59	1.65	.46	.16	<.02	30	110	740	<3	7	14
30492086	49	2	86	203.83	22.6	7.0	3.26	1.59	32.10	1.08	.84	.30	.12	<.02	<20	90	650	<3	<5	10
30501023	50	1	23	204.59	24.9	7.6	3.60	1.75	29.60	1.20	1.22	.33	.11	<.02	<20	100	680	<3	<5	<5
30508015	50	8	15	208.04	38.4	11.3	5.85	2.20	14.60	1.62	2.24	.58	.13	<.02	30	150	750	<3	<5	<5
30511144	51	1	44	209.85	27.6	8.2	4.04	1.70	26.30	1.47	1.38	.41	.13	<.02	<20	110	740	<3	<5	11
30512075	51	2	75	209.85	19.5	6.2	3.02	1.40	34.40	1.07	.84	.26	.11	<.02	<20	80	660	<3	<5	8
30512076	51	2	75	210.74	19.5	6.2	3.06	1.36	34.40	1.02	.90	.26	.11	<.02	<20	90	680	<3	9	7
30513014	51	3	14	211.17	18.4	5.6	2.70	1.27	36.20	1.12	.84	.24	.10	<.02	<20	120	650	<3	6	7
30518002	51	8	2	212.24	31.7	9.6	4.89	1.88	21.30	1.54	1.60	.47	.13	<.02	<20	120	720	<3	<5	10
30521064	52	1	64	214.51	16.5	5.0	2.43	1.14	37.90	.92	.58	.22	.09	<.02	<20	90	490	<3	<5	<5
30522141	52	2	141	220.81	26.6	8.2	4.44	1.91	24.20	1.60	1.30	.50	.14	<.02	<20	110	720	<3	9	14
30541081	54	1	81	222.68	12.5	3.7	1.81	.98	42.60	.61	.19	.14	.10	<.02	<20	90	540	<3	<5	<5
30542118	54	2	118	222.84	14.0	3.8	1.80	.97	41.00	.79	.35	.15	.09	<.02	<20	90	560	<3	<5	<5
30552109	55	2	107	226.07	26.0	7.4	3.94	1.50	27.60	1.55	1.14	.34	.11	<.02	<20	80	650	<3	<5	<5
30561100	56	1	100	229.00	19.3	5.5	2.94	3.99	32.70	.87	.75	.22	.09	<.02	<20	120	680	<3	<5	5
30562034	56	2	34	229.84	26.7	7.8	3.77	1.61	27.40	1.34	1.10	.35	.11	<.02	30	180	680	3	<5	7
30571118	57	1	118	232.58	28.6	7.2	3.70	1.49	26.50	1.46	1.04	.33	.11	<.02	<20	90	610	<3	<5	11

Table 4B. Chemical analyses of samples from Leg 75, Hole 532B.

Sample	Core	Section	Interval	DEPTH m	% SiO2	% Al2O3	% Fe2O3	% MgO	% CaO	% Na2O	% K2O	% TiO2	% P2O5	% MnO	ppm As	ppm B	ppm Ba	ppm Be	ppm Cd	ppm Co
40582093	58	2	93	238.23	20.0	5.6	2.55	1.43	35.60	1.00	.70	.23	.09	<.02	<20	90	440	<3	12	6
40585000	58	8	0	239.71	25.4	6.4	3.15	1.30	30.40	1.29	.87	.27	.10	<.02	<20	130	590	<3	<5	9
40591080	59	1	80	240.60	29.5	8.2	3.78	1.72	26.60	1.37	1.26	.37	.11	<.02	<20	90	620	<3	<5	12
40592106	59	2	106	242.36	34.9	8.3	3.99	1.67	21.60	1.50	1.44	.38	.15	<.02	<20	110	660	<3	<5	11
40592107	59	2	106	242.36	34.7	8.2	3.95	1.66	21.60	1.46	1.48	.38	.14	<.02	<20	110	600	<3	<5	11
40613005	61	3	5	250.25	28.5	8.0	3.70	1.67	27.10	1.34	1.17	.35	.15	<.02	<20	80	620	<3	<5	12
40622124	62	2	124	253.94	18.5	5.4	2.50	1.28	37.20	.84	.43	.23	.11	<.02	<20	110	540	<3	<5	<5
40641082	64	1	82	258.52	20.5	5.8	2.58	1.27	34.50	1.05	.70	.23	.09	<.02	<20	60	530	<3	<5	<5
40651051	65	1	51	260.21	29.3	7.8	3.75	1.60	26.00	1.49	1.20	.34	.13	<.02	<20	140	680	<3	<5	29
40661085	66	1	85	264.55	21.5	6.2	2.71	1.45	34.10	1.10	.84	.24	.11	<.02	<20	70	550	<3	<5	6
40661086	66	1	85	264.55	21.5	6.2	2.74	1.45	34.30	1.06	.74	.24	.11	<.02	<20	80	590	<3	9	11
40668007	66	8	7	267.12	30.7	8.5	4.24	1.63	23.10	1.50	1.43	.39	.13	<.02	<20	200	790	<3	100	11
40672061	67	2	61	269.21	26.4	7.6	3.83	1.59	27.80	1.40	1.21	.32	.12	<.02	<20	100	670	<3	10	12
40681015	68	1	15	271.65	33.8	9.2	4.78	1.81	19.50	1.60	1.67	.42	.15	<.02	<20	80	580	<3	<5	7
40692115	69	2	115	278.15	21.6	6.5	2.90	1.92	33.20	1.02	.68	.25	.10	<.02	<20	70	510	<3	<5	7
40712076	71	2	76	284.56	12.1	3.8	1.70	.99	42.80	.69	.34	.14	.09	<.02	<20	50	520	<3	<5	<5
40732014	73	2	14	289.94	17.7	5.5	2.55	1.19	36.40	.95	.76	.22	.10	<.02	<20	60	520	<3	6	<5

liferous, hydrothermal solutions. Slight increases in concentrations of several elements (e.g., Fe and Mg) and in the Fe:Al ratio in the first meter of section above basalt (below about 1101 m sub-bottom), may be the result of leaching of basalt by seawater as proposed by Bertine (1974). Such leaching probably was not very extensive and resulted only in minor enrichment of a few elements for a short distance above the contact. Lack of enrichment of Mn, B, Ba, Zn, Cu, Ni, Co, Cr, and other hydrothermal "indicator" elements suggests that introduction of metals by hydrothermal solutions venting at the seafloor was unlikely.

Table 4A. (Continued).

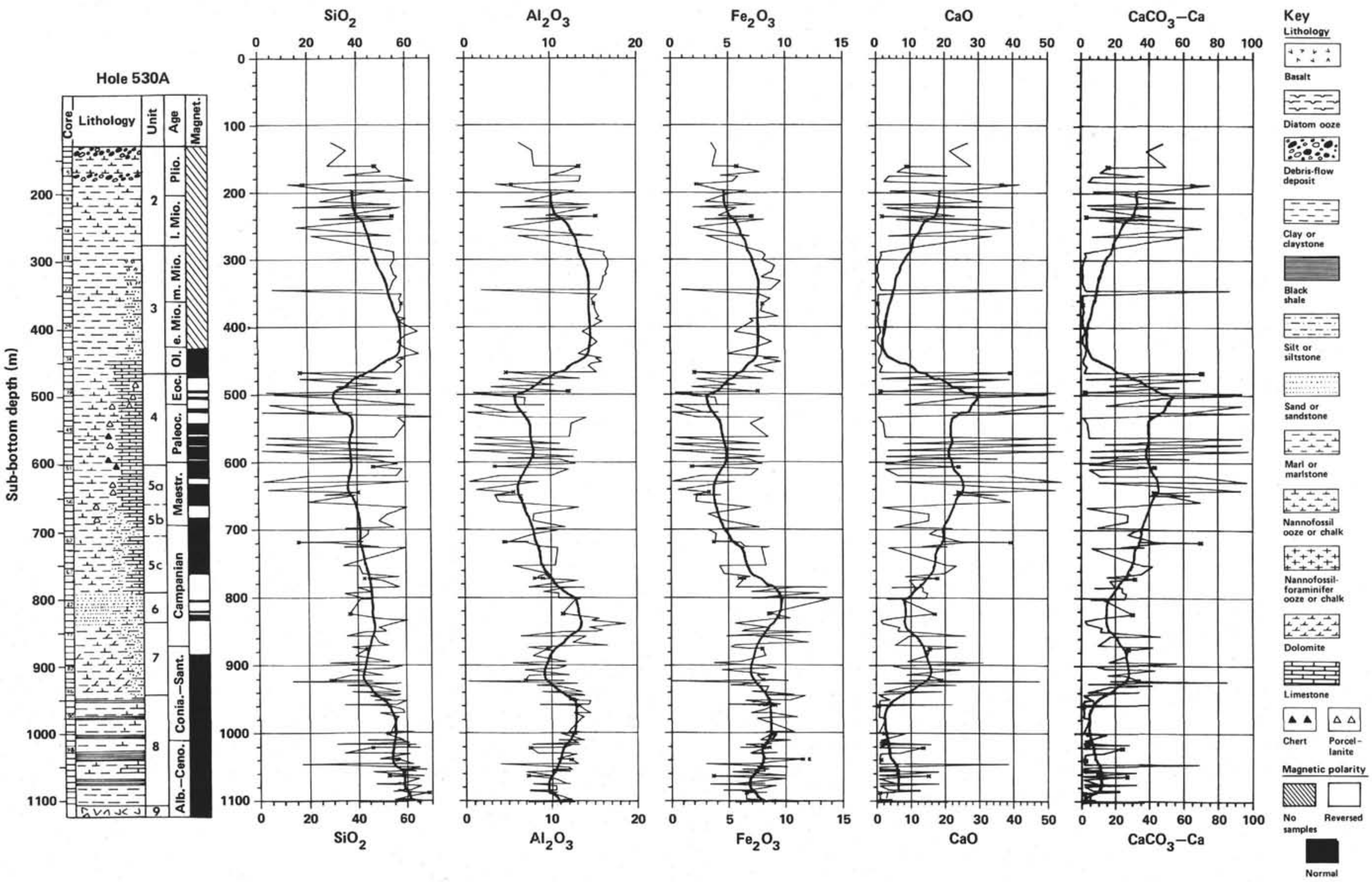
ppm Cr	ppm Cu	ppm Ga	ppm Li	ppm Mo	ppm Ni	ppm Pb	ppm Sc	ppm Sr	ppm Th	ppm U	ppm V	ppm Zn	ppm Zr	ppm Y	ppm La	ppm Ce	ppm Nd	ppm Dy	ppm Yb	% CaCO3
71	36	<20	24	30	41	<20	6	820	<10	<100	42	54	<10	13	<5	<30	<50	<5	<2	65.0
77	43	<20	55	35	36	<20	5	850	<10	<100	74	57	60	11	10	<30	<50	7	<2	50.9
37	31	<20	31	8	27	<20	<5	1,300	20	<100	36	71	20	10	7	<30	<50	6	<2	74.8
120	60	<20	55	39	66	<20	15	860	<10	<100	80	100	<10	22	17	<30	<50	<5	<2	43.0
64	55	<20	44	29	48	<20	7	730	20	<100	69	65	50	10	6	<30	<50	<5	<2	44.6
98	43	70	47	32	61	20	13	980	30	<100	75	92	80	23	15	<30	50	<5	3	54.1
62	35	<20	32	23	38	<20	8	690	<10	<100	63	54	30	9	9	<30	<50	<5	<2	41.6
120	38	50	59	21	62	<20	11	650	<10	100	82	79	<10	18	22	30	<50	21	2	38.4
61	19	<20	28	12	35	<20	7	850	<10	<100	39	57	10	13	<5	<30	<50	9	<2	62.1
61	21	<20	33	11	34	<20	<5	890	<10	<100	42	41	90	10	5	<30	<50	<5	<2	58.2
95	50	110	55	30	51	100	24	990	100	600	62	81	40	28	55	180	100	52	6	57.9
98	44	<20	40	16	56	90	7	780	<10	<100	57	65	60	15	<5	<30	<50	<5	<2	48.6
52	39	<20	26	17	30	<20	<5	960	<10	<100	38	50	30	7	8	<30	<50	<5	<2	61.8
89	56	<20	59	24	61	<20	12	550	20	<100	86	92	80	17	12	<30	70	25	2	34.3
100	50	<20	40	31	63	30	8	540	<10	<100	61	92	40	13	8	<30	<50	11	<2	29.1
100	48	30	52	32	67	<20	10	510	20	<100	68	100	80	17	11	30	50	12	2	29.1
75	36	70	34	24	52	<20	<5	1,000	30	200	44	48	60	14	10	60	<50	<5	<2	48.7
42	26	40	21	17	41	<20	8	920	10	<100	32	39	<10	11	15	<30	60	<5	<2	49.1
160	120	<20	78	28	110	50	15	480	140	<100	130	130	90	20	11	<30	330	180	10	22.0
41	35	<20	29	14	33	<20	<5	960	<10	<100	49	48	40	6	<5	<30	<50	10	<2	50.2
140	44	40	50	15	72	<20	13	990	<10	<100	61	62	<10	18	16	40	<50	<5	<2	50.2
81	48	<20	36	17	53	20	8	690	<10	<100	62	77	40	10	<5	<30	<50	14	<2	34.8
120	68	20	45	27	84	<20	16	330	<10	<100	72	110	50	23	16	50	<50	<5	2	16.4
75	33	<20	30	11	37	<20	<5	580	<10	<100	49	56	90	11	<5	<30	<50	<5	2	39.1
77	28	50	35	7	43	<20	10	1,000	10	100	39	42	<10	12	17	40	<50	<5	<2	53.6
180	80	20	61	30	93	<20	22	330	<10	<100	120	130	120	30	23	30	60	8	<2	13.1
110	44	<20	47	15	59	<20	16	590	<10	<100	81	110	<10	19	24	30	<50	5	<2	28.2
96	44	40	44	15	55	<20	9	850	20	<100	68	72	70	18	11	60	<50	18	2	48.4
190	80	40	79	24	100	<20	18	410	10	<100	110	110	<10	27	27	30	<50	13	3	17.3
130	50	<20	44	13	78	<20	15	900	10	<100	84	100	10	23	25	50	<50	6	<2	43.7
180	100	<20	76	23	98	<20	17	320	<10	<100	130	120	110	24	24	<30	<50	11	3	12.9
71	17	<20	31	<5	30	<20	7	870	<10	<100	50	47	20	11	<5	<30	<50	<5	<2	53.0
110	41	100	47	5	41	<20	<5	1,300	30	200	74	69	80	22	11	60	50	18	5	55.7
140	64	20	49	11	84	20	17	760	20	<100	97	120	30	26	28	40	<50	<5	<2	36.8
70	40	<20	27	7	35	<20	8	920	<10	<100	47	56	10	13	<5	<30	<50	<5	<2	56.6
140	58	30	45	12	73	<20	15	530	20	<100	81	96	70	26	17	60	<50	14	3	31.1
70	41	<20	41	<5	34	<20	8	910	<10	<100	53	63	50	10	7	<30	<50	<5	<2	52.1
110	38	100	61	12	58	<20	16	1,200	<10	300	81	78	90	22	13	80	<50	17	3	53.2
150	61	<20	51	8	84	<20	18	720	10	<100	92	120	20	27	25	60	<50	7	2	35.0
120	33	<20	37	<5	48	<20	<5	620	<10	<100	60	82	70	9	<5	<30	<50	<5	<2	37.9
110	58	<20	47	<5	47	30	11	840	60	<100	86	82	60	17	<5	40	110	76	5	43.7
130	63	<20	61	12	63	<20	10	690	<10	<100	89	84	80	18	12	<30	<50	12	<2	34.3
56	18	<20	28	<5	28	<20	7	1,200	<10	<100	52	46	<10	11	18	40	<50	<5	<2	63.6
87	25	20	40	6	30	<20	8	950	10	<100	56	43	50	13	15	<30	<50	11	<2	56.6
180	32	100	57	13	77	40	30	240	30	200	110	69	310	39	36	60	<50	47	4	34.8
160	65	60	67	9	78	<20	22	930	<10	<100	97	120	120	25	28	70	<50	13	3	38.9
170	80	<20	65	8	90	50	22	850	80	300	100	100	80	25	19	60	190	99	6	38.4
84	37	20	42	<5	36	<20	11	1,200	<10	<100	60	57	50	14	13	30	<50	<5	<2	57.3
100	36	<20	44	<5	48	<20	12	1,200	<10	<100	71	78	20	17	17	30	<50	<5	<2	52.9
190	79	<20	55	<5	79	<20	10	580	<10	<100	100	120	90	16	<5	<30	<50	25	<2	26.1
150	58	90	61	9	60	<20	17	1,100	<10	<100	86	120	120	25	28	60	<50	5	3	47.0
89	30	40	39	10	49	<20	13	1,400	<10	<100	59	78	80	15	19	40	<50	<5	<2	61.4
93	33	70	41	8	34	20	12	1,400	<10	<100	61	80	80	16	17	50	60	6	3	61.4
67	37	50	36	8	52	20	6	1,400	<10	<100	84	110	50	12	11	<30	<50	<5	<2	64.6
120	64	<20	56	9	57	<20	13	750	<10	<100	72	140	70	18	13	30	<50	<5	<2	38.0
68	28	<20	29	<5	31	<20	<5	1,200	<10	<100	44	55	40	9	<5	<30	<50	9	<2	67.7
150	84	80	60	20	99	<20	17	1,000	<10	<100	110	120	120	25	30	80	<50	15	6	43.2
53	31	30	27	<5	32	<20	<5	1,600	<10	<100	37	37	<10	9	20	<30	<50	18	2	76.1
59	24	70	30	<5	32	<20	<5	1,500	<10	<100	35	36	<10	11	17	<30	<50	<5	<2	73.2
83	31	<20	23	<5	34	<20	<5	1,000	<10	<100	50	89	20	<5	<5	<30	<50	<5	<2	49.3
57	18	80	40	<5	33	<20	14	1,100	10	200	48	35	<10	11	18	50	<50	<5	<2	58.4
110	47	<20	57	5	58	20	14	1,100	20	<100	70	83	<10	18	19	<30	<50	20	<2	48.9
120	61	50	45	7	64	<20	18	990	30	500	81	92	40	24	10	60	<50	<5	<2	47.3

Table 4B. (Continued).

ppm Cr	ppm Cu	ppm Ga	ppm Li	ppm Mo	ppm Ni	ppm Pb	ppm Sc	ppm Sr	ppm Th	ppm U	ppm V	ppm Zn	ppm Zr	ppm Y	ppm La	ppm Ce	ppm Nd	ppm Dy	ppm Yb	% CaCO3
67	16	50	33	<5	27	<20	9	1,000	10	100	45	49	40	12	<5	60	<50	12	<2	63.6
120	39	60	47	6	64	<20	9	1,100	10	<100	61	59	<10	15	23	30	<50	<5	<2	54.3
100	29	30	46	<5	49	<20	15	970	20	<100	84	83	<10	20	23	70	<50	5	<2	47.5
120	43	20	51	<5	63	<20	17	790	10	<100	82	99	<10	22	23	50	<50	<5	2	38.6
94	49	50	57	8	49	20	14	720	10	200	70	92	60	18	19	60	<50	13	<2	38.6
99	46	<20	51	<5	52	<20	13	1,000	30	100	81	75	60	22	<5	50	50	29	2	48.4
64	22	60	36	<5	29	<20	<5	1,400	20	<100	46	40	<10	14	21	<30	60	<5	<2	66.4
54	31	<20	49	<5	21	<20	7	1,300	20	<100	59	41	50	12	12	<30	<50	16	<2	61.6
140	59	200	60	19	72	110	33	970	50	1,200	75	97	50	37	63	230	<50	14	<2	46.4
66	21	80	39	<5	28	<20	15	1,200	<10	100	58	58	70	17	14	50	80	8	2	60.9
69	22	90	49	<5	28	<20	7	1,300	<10	100	67	69	70	16	23	70	<50	<5	4	61.2
150	85	100	84	14	78	<20	14	990	20	200	110	100	100	29	25	80	<50	38	6	41.2
100	58	70	59	9	68	<20	11	1,100	<10	<100	100	99	90	27	24	70	<50	7	3	49.6
120	64	<20	47	8	79	<20	14	640	<10	<100	85	98	30	22	11	30	<50	<5	<2	34.8
53	22	<20	37	<5	21	<20	7	1,100	<10	<100	49	48	40	10	<5	<30	<50	<5	<2	59.3
51	28	<20	25	<5	27	20	8	1,600	20	<100	40	50	<10	14	18	40	<50	<5	<2	76.4
52	38	<20	40	<5	27	<20	5	1,200	<10	<100	53	47	40	12	<5	<30	<50	<5	<2	65.0

Geochemistry of Color Cycles at Site 532

The entire section recovered at Site 532 is characterized by distinct dark-light color cycles. Preliminary shipboard descriptions of the section at Site 532 noted cycles of dark- and light-colored sediment that contain abrupt changes in abundances of foraminifers and diatoms (Site 532, this volume), but these changes in microfossil abundance are not systematic within the color cycles. The concentration of $CaCO_3$, however, does change systematically within individual color cycles and is highest in the lighest-colored part of a cycle. Average periodicities of the color and $CaCO_3$ cycles are about 40,000 years (Gardner et al., this volume). The dark parts of


Hole 530A
Core
Lithology
Unit
Age
Magnet.
Sub-bottom depth (m)
Plio.
l. Mio.
m. Mio.
e. Mio.
Ol.
Eoc.
Paleoc.
Maestr.
Campanian
Conia.–Sant.
Alb.–Ceno.
2
3
4
5a
5b
5c
6
7
8
9
SiO_2
Al_2O_3
Fe_2O_3
CaO
$CaCO_3$–Ca
Key
Lithology
Basalt
Diatom ooze
Debris-flow deposit
Clay or claystone
Black shale
Silt or siltstone
Sand or sandstone
Marl or marlstone
Nannofossil ooze or chalk
Nannofossil-foraminifer ooze or chalk
Dolomite
Limestone
Chert
Porcel-lanite
Magnetic polarity
No samples
Reversed
Normal

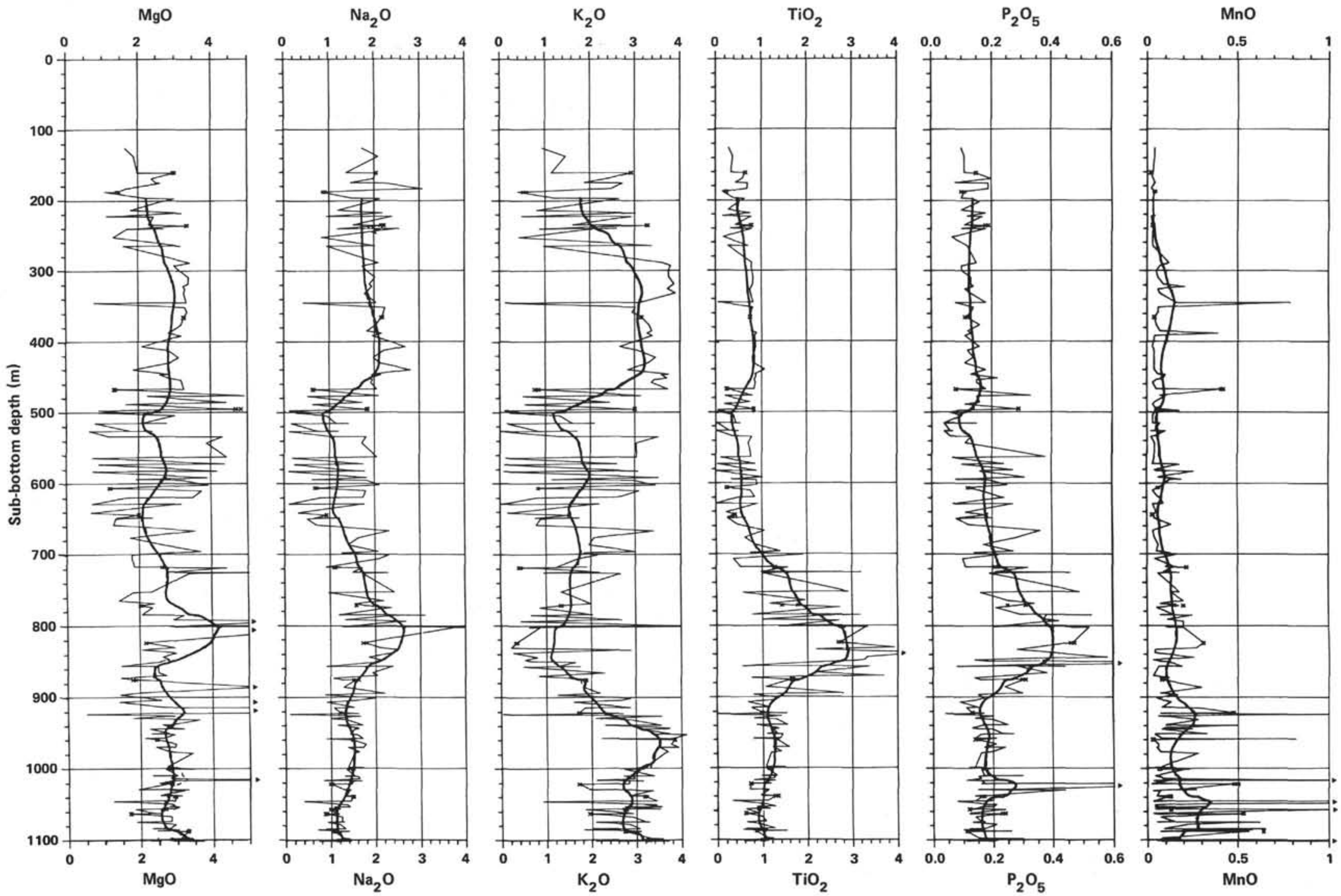
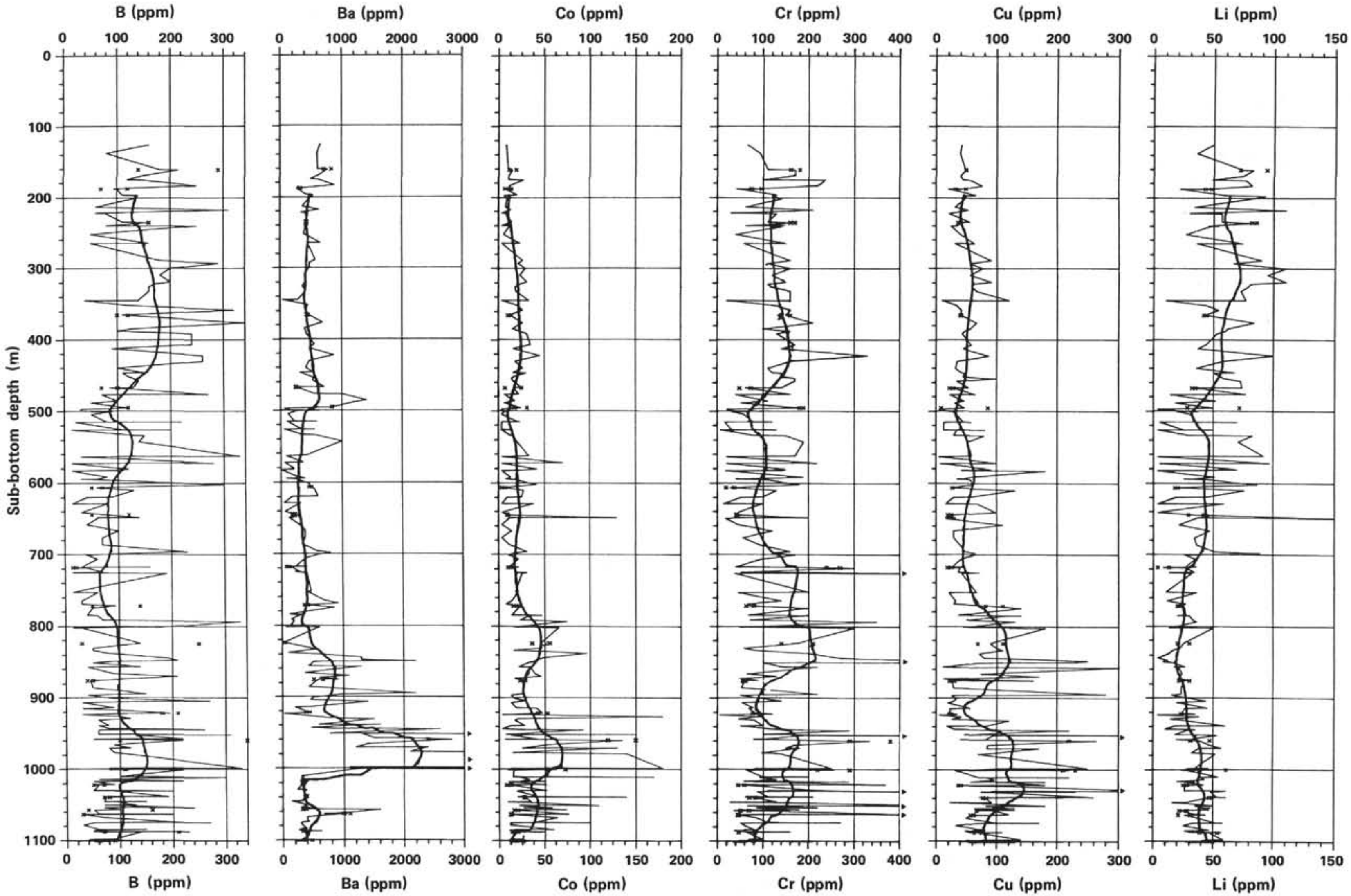


Figure 2. Lithologic summary, ages, paleomagnetics, and plots of concentrations of major-element oxides and $CaCO_3$ (in percent) and trace elements (in parts per million, ppm) in samples from Hole 530A. Duplicate analyses are indicated by two points plotted as "x" at the same depth.


B (ppm)
Ba (ppm)
Co (ppm)
Cr (ppm)
Cu (ppm)
Li (ppm)
Sub-bottom depth (m)
0
100
200
300
400
500
600
700
800
900
1000
1100
1000
2000
3000
50
150
150

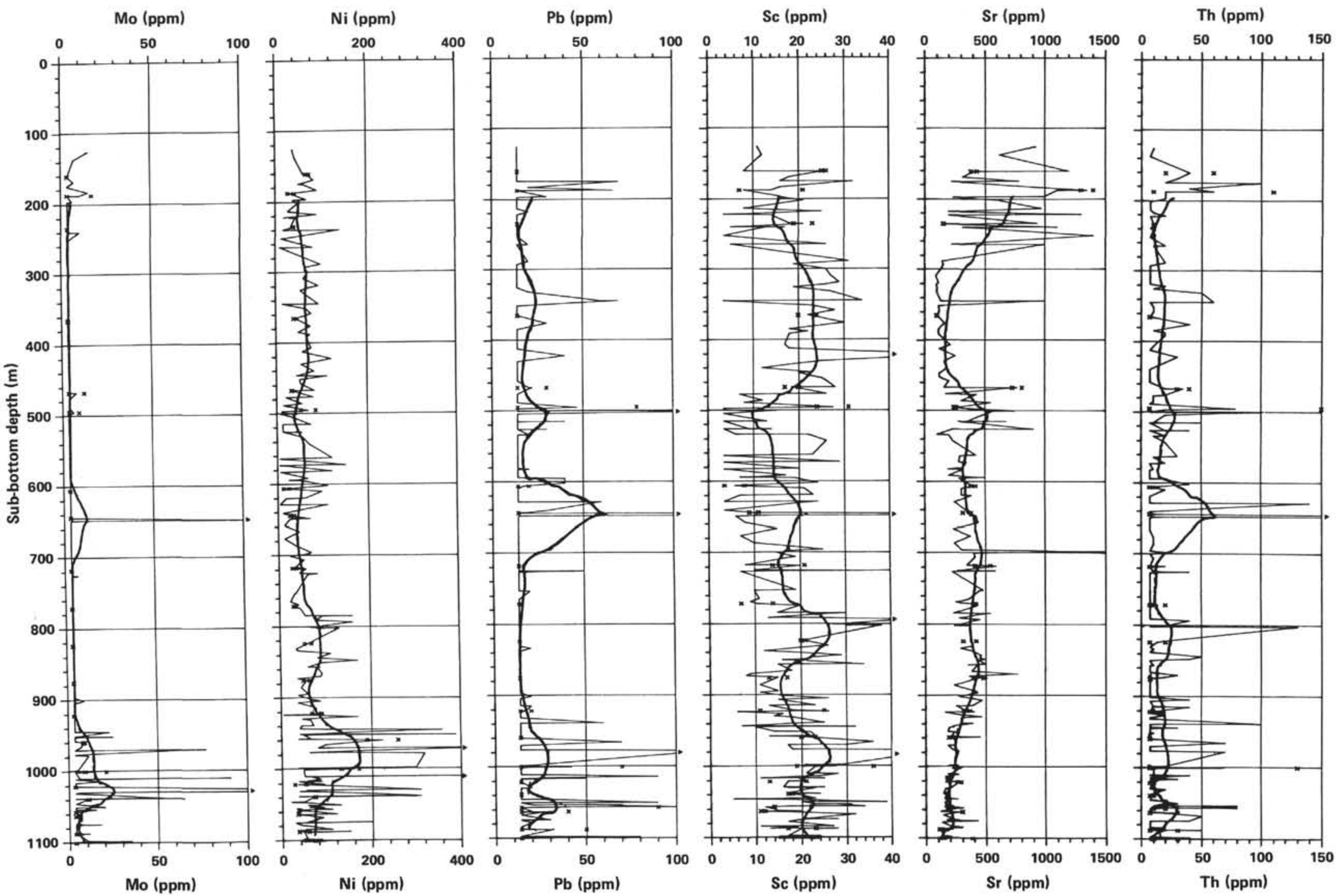


Figure 2. (Continued).

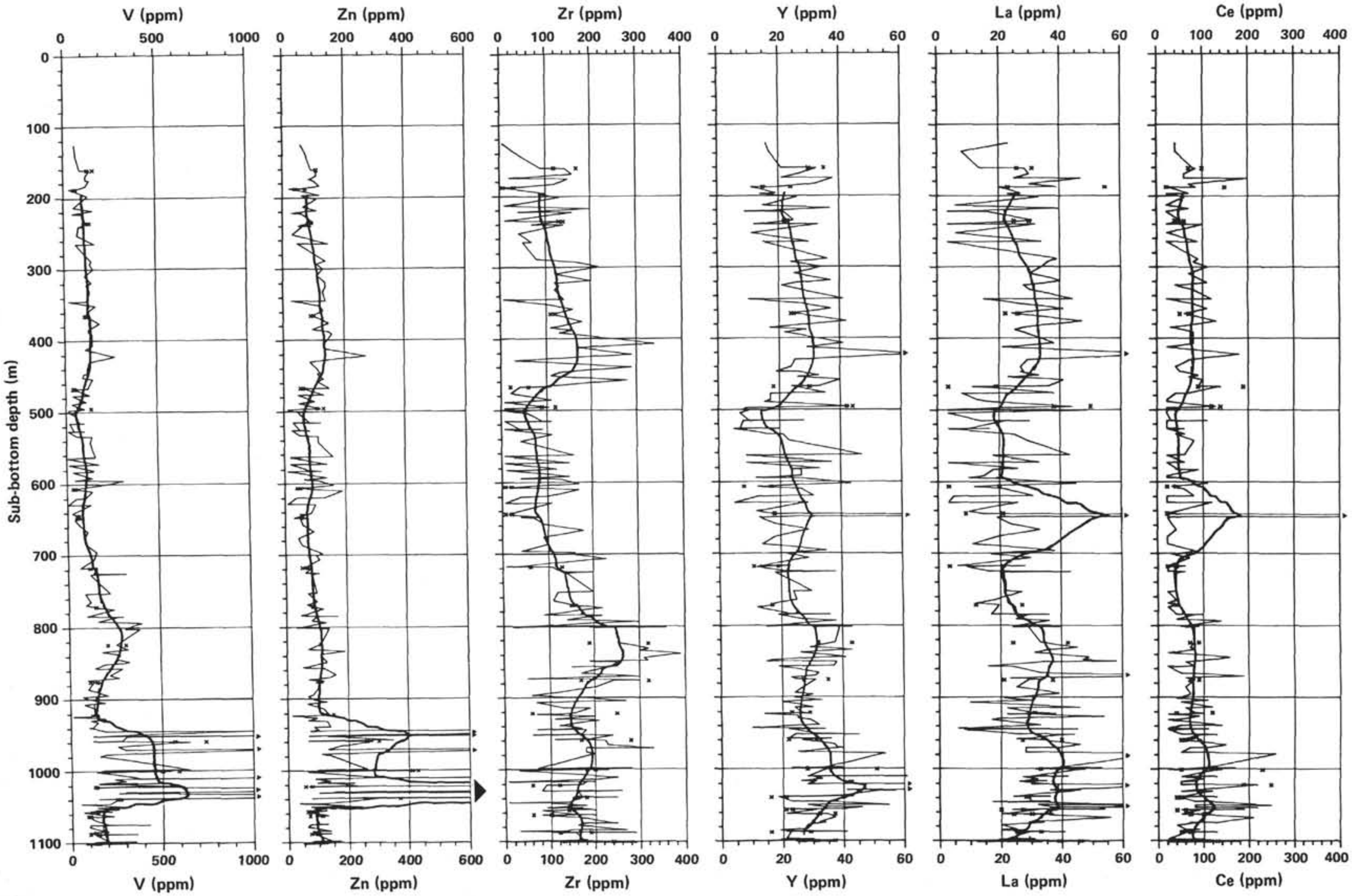


Figure 2. (Continued).

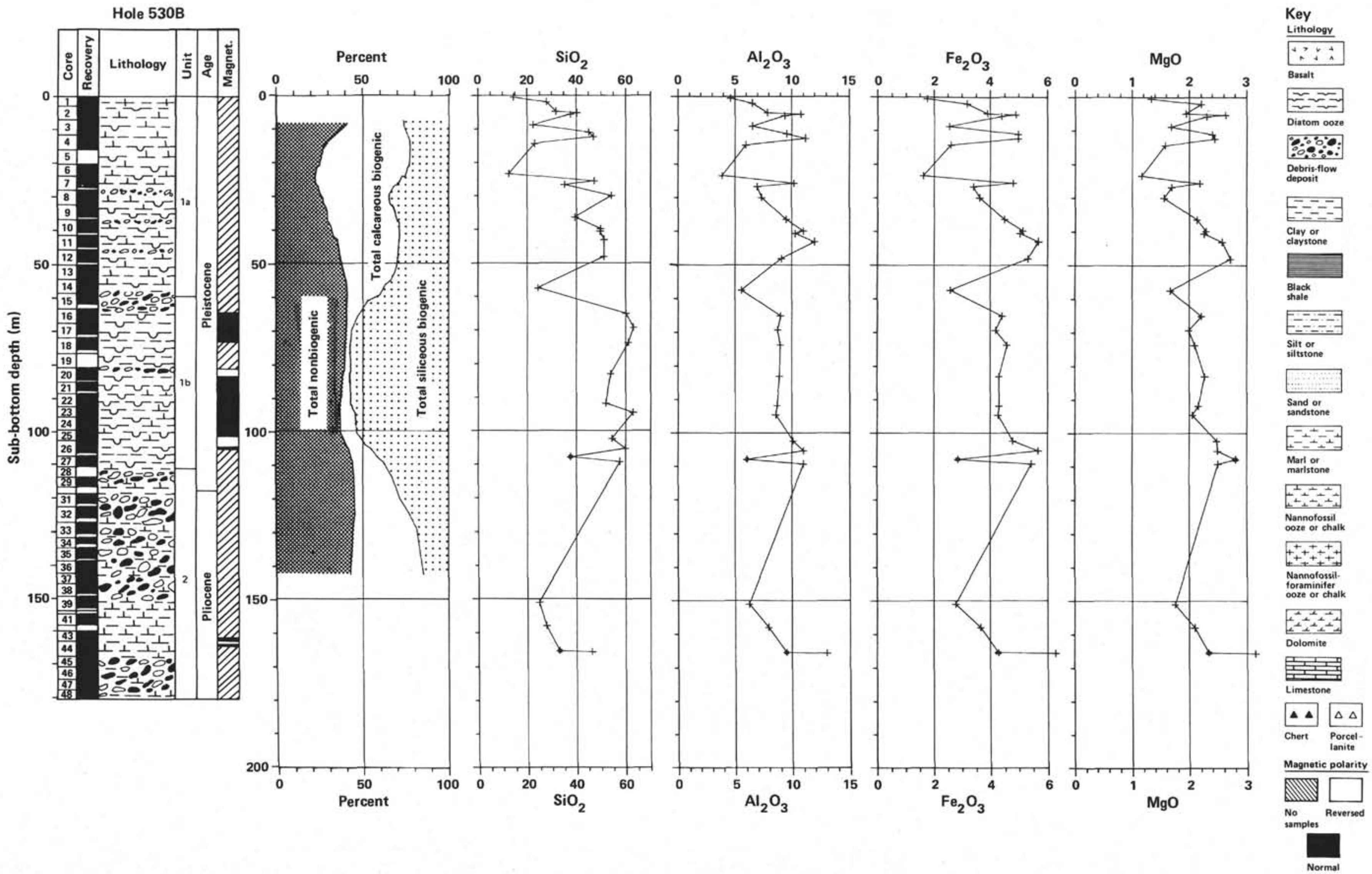
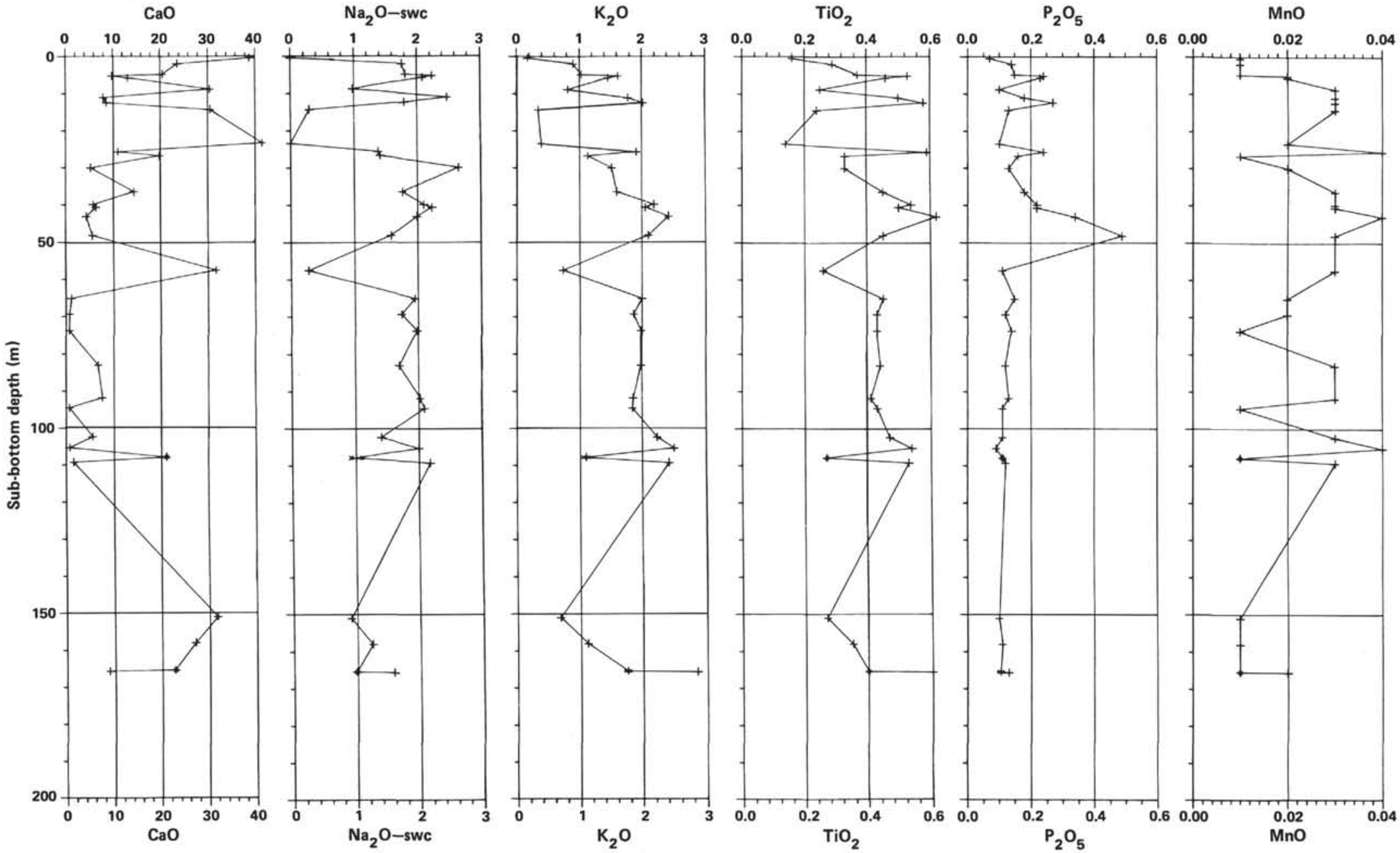


Figure 3. Lithologic summary, ages, paleomagnetics, percentages of total nonbiogenic, calcareous biogenic, and siliceous biogenic components in sediment, and plots of concentrations of major-element oxides (in percent) and trace elements (in parts per million, ppm) in samples from Hole 530B. Duplicate analyses are indicated by two points plotted as "x" at the same depth. Curves for percentages of sediment components were obtained by smoothing smear-slide data (see site summaries) using a seven-point weighted moving average. Concentrations of Na_2O have been corrected for interstitial seawater sodium (swc; see text for method of correction).


CaO
Na2O—swc
K2O
TiO2
P2O5
MnO
Sub-bottom depth (m)
0
50
100
150
200
0 10 20 30 40
0 1 2 3
0.0 0.2 0.4 0.6
0.00 0.02 0.04

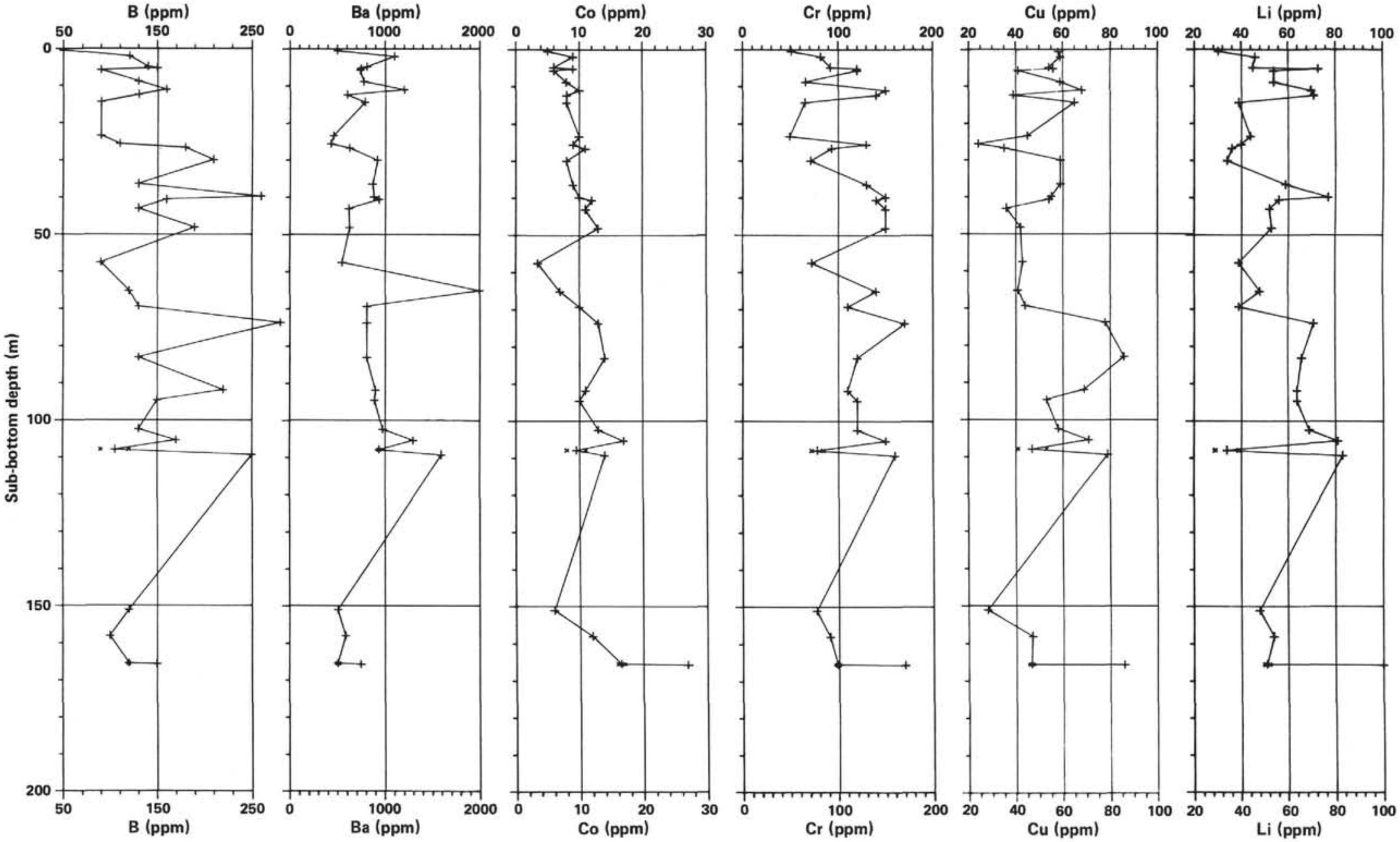
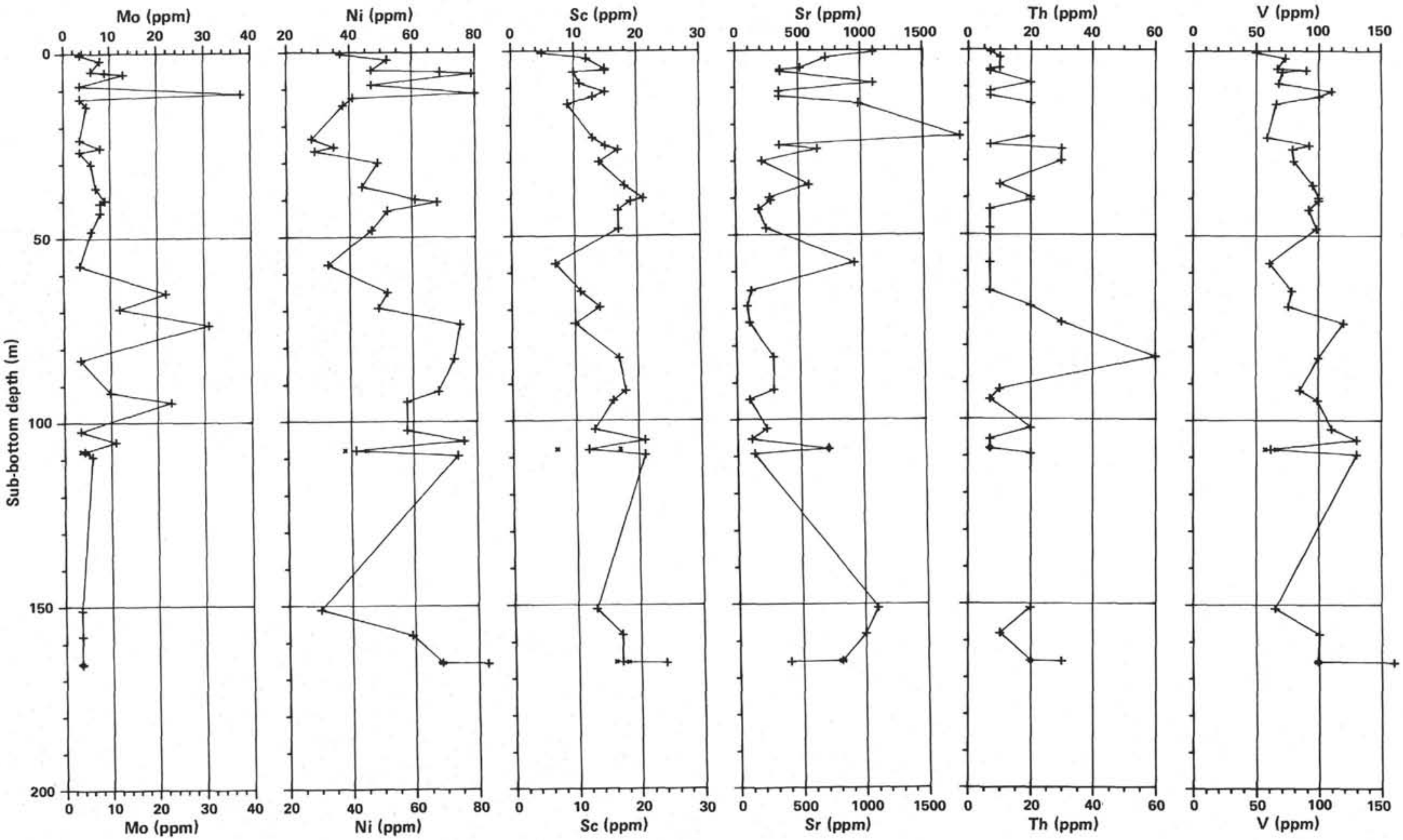


Figure 3. (Continued).


Mo (ppm)
Ni (ppm)
Sc (ppm)
Sr (ppm)
Th (ppm)
V (ppm)
Sub-bottom depth (m)
0
50
100
150
200
0 10 20 30 40
20 40 60 80
0 10 20 30
0 500 1000 1500
0 20 40 60
0 50 100 150

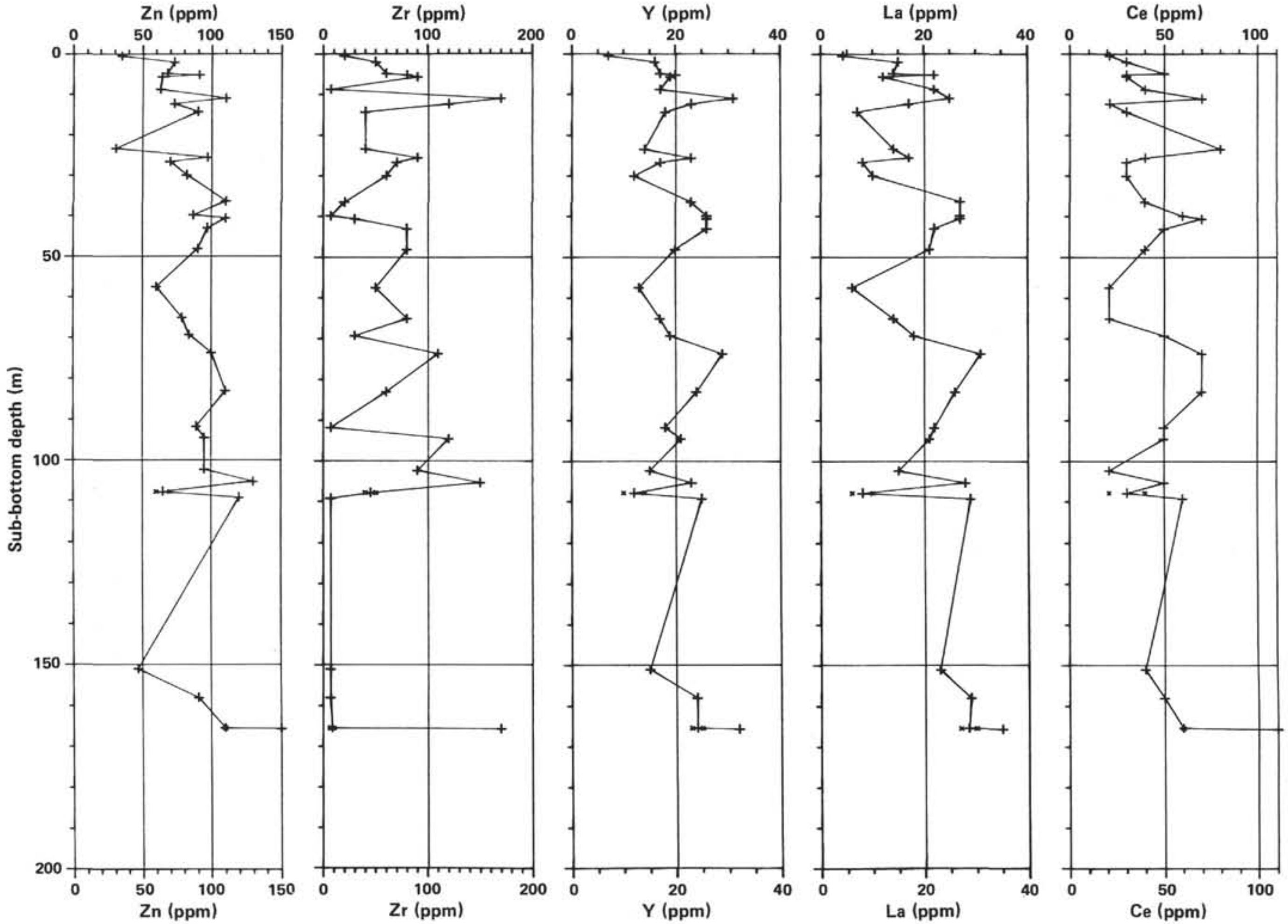
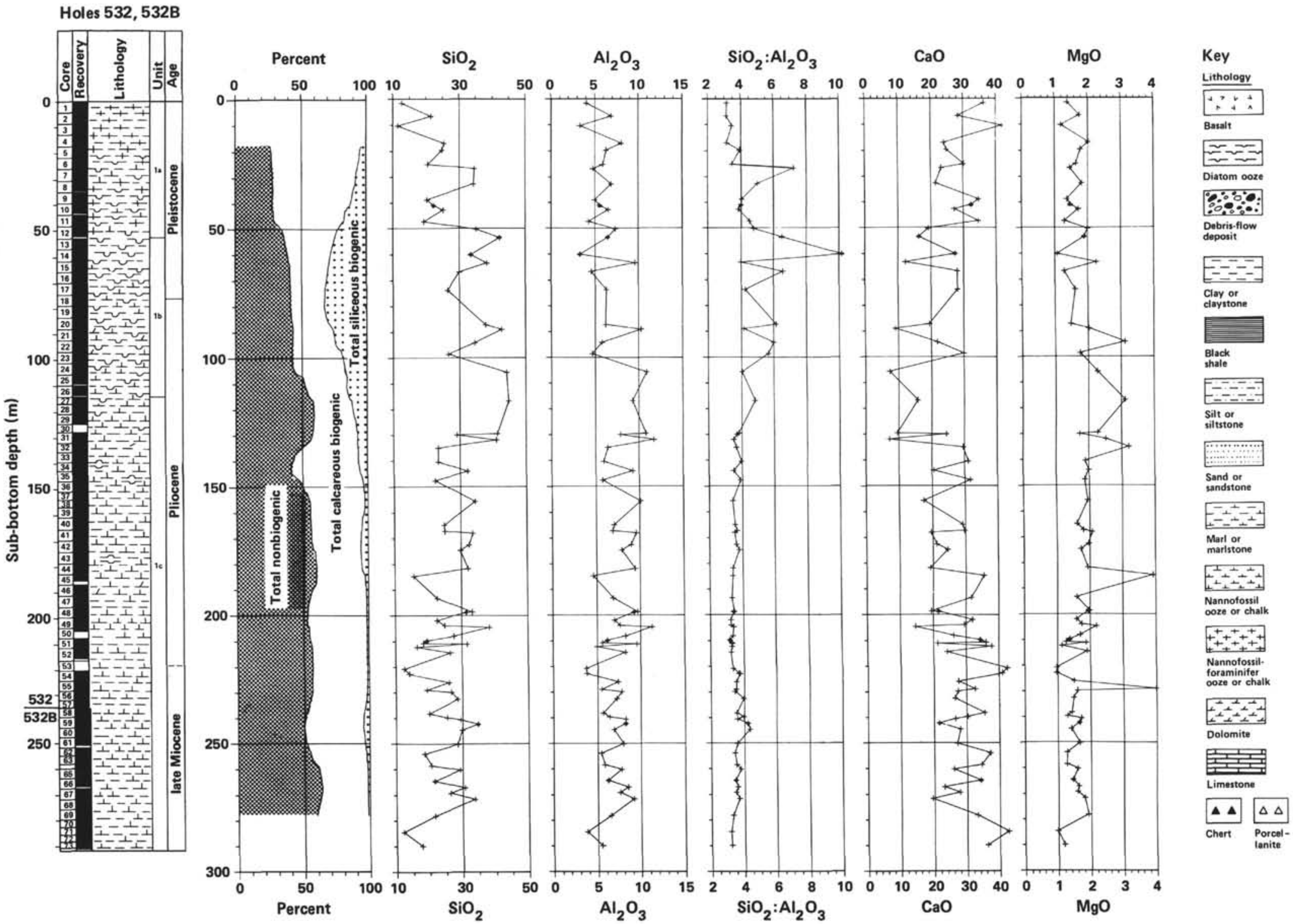


Figure 3. (Continued).


Holes 532, 532B
Core
Recovery
Lithology
Unit
Age
Sub-bottom depth (m)
532
532B
Pleistocene
Pliocene
late Miocene
Percent
Total nonbiogenic
Total calcareous biogenic
Total siliceous biogenic
SiO2
Al2O3
SiO2:Al2O3
CaO
MgO
Key
Lithology
Basalt
Diatom ooze
Debris-flow deposit
Clay or claystone
Black shale
Silt or siltstone
Sand or sandstone
Marl or marlstone
Nannofossil ooze or chalk
Nannofossil-foraminifer ooze or chalk
Dolomite
Limestone
Chert
Porcel-lanite

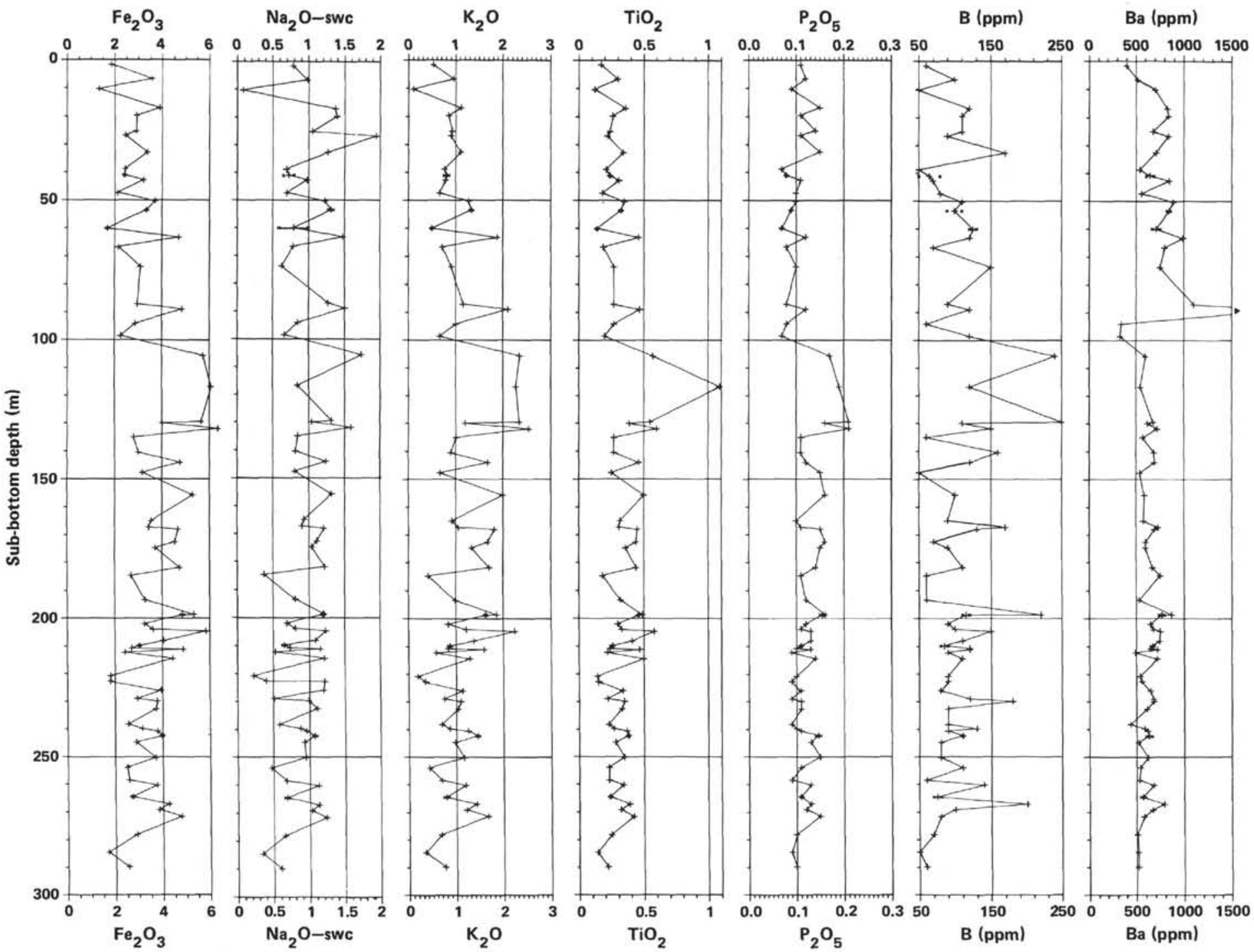
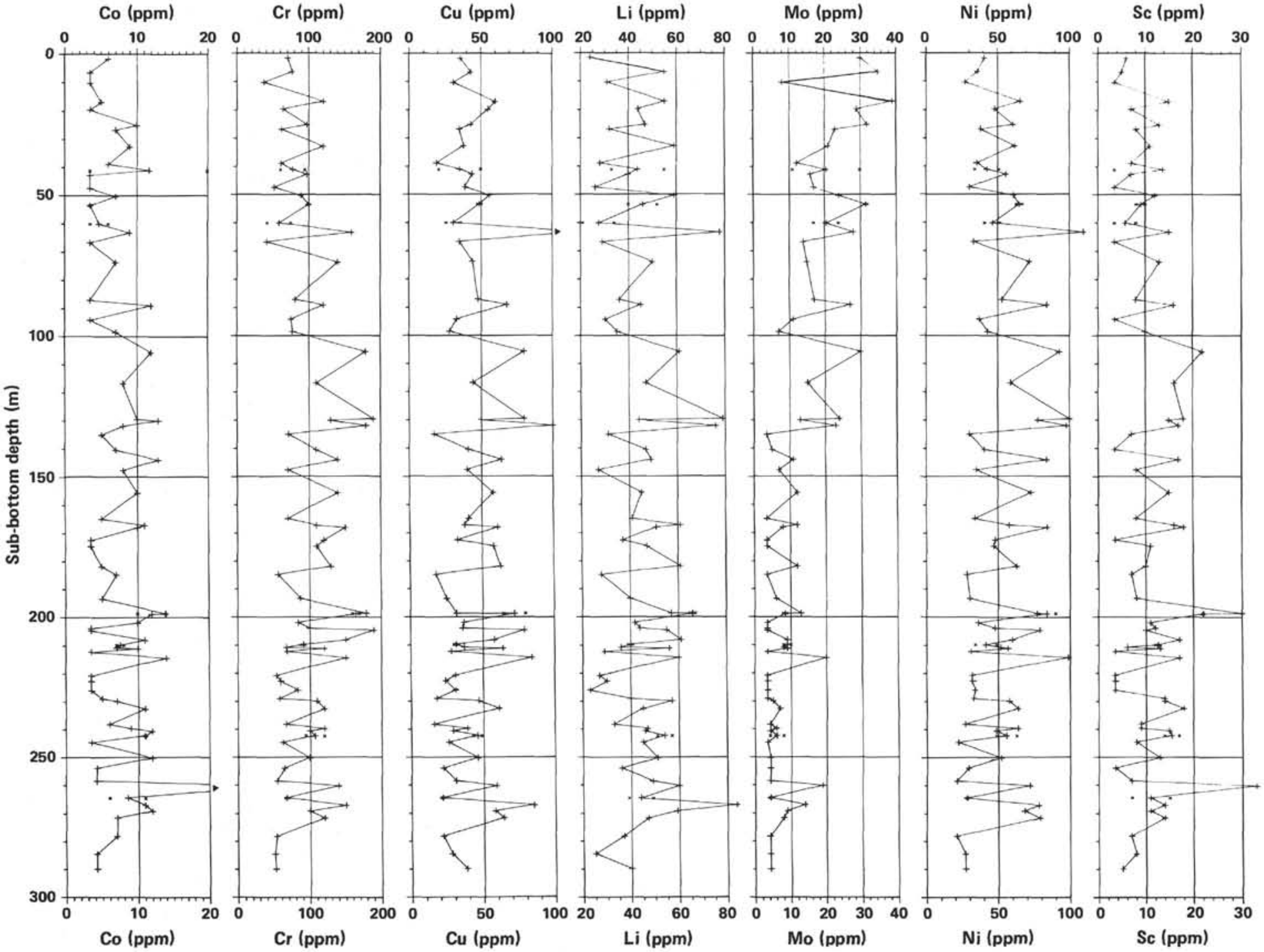


Figure 4. Lithologic summary, ages, percentages of total nonbiogenic, calcareous biogenic, and siliceous biogenic components in sediment, and plots of concentrations of major-element oxides (in percent) and trace elements (in parts per million, ppm) in samples from Holes 532 and 532B. Duplicate analyses are indicated by two points plotted as "x" at the same depth. Curves for percentages of sediment components were obtained by smoothing smear-slide data (see site summaries) using a seven-point weighted moving average. Concentrations of Na_2O have been corrected for interstitial seawater sodium (swc; see text for method of correction).


Co (ppm)
Cr (ppm)
Cu (ppm)
Li (ppm)
Mo (ppm)
Ni (ppm)
Sc (ppm)
Sub-bottom depth (m)

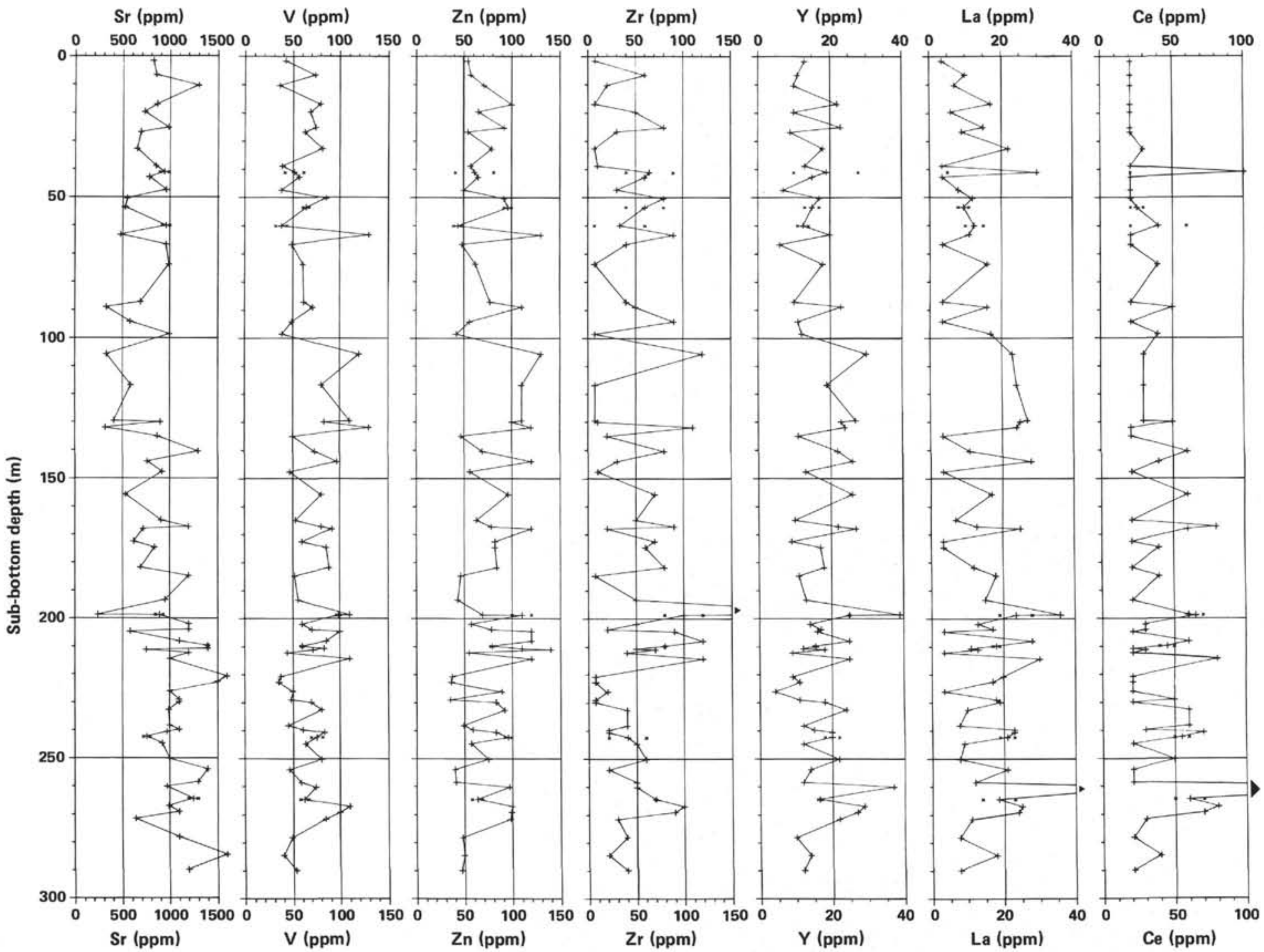


Figure 4. (Continued).

Table 5. Summary statistics for concentrations of major-element oxides and trace elements in nine samples of volcanogenic sandstone turbidites in lithologic Unit 6, Hole 530A.

Component	Min.	Max.	GM	GD
Oxide (%)				
SiO_2	34.7	48.6	41.7	1.127
Al_2O_3	9.2	15.6	12.0	1.169
Fe_2O_3	7.0	13.8	10.1	1.316
MgO	2.2	8.2	4.1	1.776
CaO	3.1	17.0	8.7	2.034
Na_2O	1.3	4.9	2.4	1.680
K_2O	0.22	4.73	0.73	2.752
TiO_2	1.02	3.93	2.49	1.564
P_2O_5	0.20	0.52	0.40	1.377
MnO	0.10	0.31	0.19	1.550
Element (ppm)				
As	14	50	16	1.528
B	14	330	67	2.948
Ba	36	610	126	2.673
Be	2.1	2.1	2.1	—
Cd	3.5	190	9.5	3.833
Co	16	75	43	1.659
Cr	48	350	150	2.090
Cu	44	180	95	1.616
Ga	14	120	28	2.380
Li	13	50	25	1.515
Mo	3.5	3.5	3.5	—
Ni	35	160	77	1.568
Pb	14	14	14	—
Sc	13	45	27	1.460
Sr	240	450	330	1.252
Th	7	130	15	2.836
U	70	200	82	1.426
V	160	400	300	1.345
Zn	33	140	95	1.588
Zr	20	360	190	2.445
Y	15	43	31	1.391
La	24	45	31	1.304
Ce	40	140	72	1.440
Nd	35	350	61	2.045
Dy	3.5	150	20	2.756
Yb	1.4	10	4.3	1.820

Note: The minimum and maximum observed concentrations are given as Min. and Max., respectively. The geometric mean and geometric deviation are given as GM and GD, respectively. Dashes in column for GD indicate no variation in data.

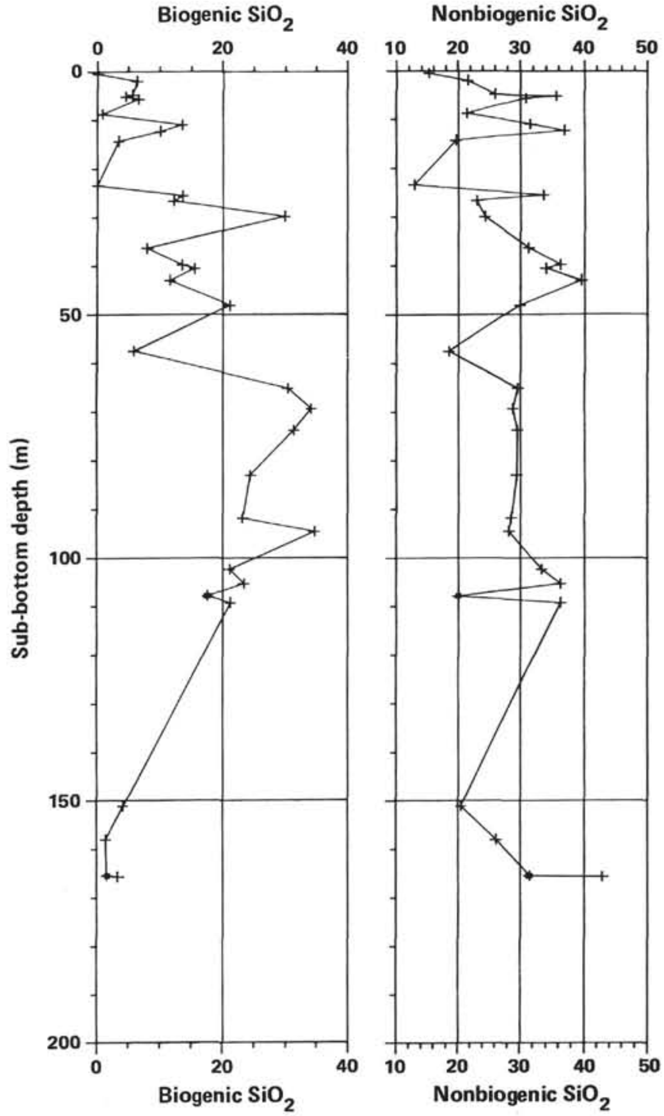


Figure 5. Plots of concentration of biogenic and nonbiogenic SiO_2 in sediment from Hole 530B. (See text for method of computation of biogenic and nonbiogenic SiO_2 from total SiO_2.)

cycles contain higher concentrations of clay and usually contain higher concentrations of organic carbon (Site 532, Meyers, Brassell, and Huc, and Gardner et al., all this volume). Gardner et al. (this volume) concluded that the dark beds of the dark-light cycles were not the result of carbonate dissolution, but rather some complex combination of influx of terrigenous clastic material and production of biogenic silica in response to fluctuations in global climate.

Because the dark parts of the cycles tend to be enriched in organic carbon relative to the light parts, we reasoned that there might be geochemical differences between the dark and light beds similar to differences observed between interbedded organic-carbon-rich and organic-carbon-poor Cretaceous strata at Site 530 (see discussion above), and elsewhere (Dean and Gardner, 1982). Ranges and geometric mean concentrations on a carbonate-free basis of trace elements and major-element oxides in 32 samples of light-colored sediment and 27 samples of dark-colored sediment from color cycles at Site 532 are given in Table 8 and plotted in Figure 13. In general, these results show that there are no major geochemical differences between dark and light sediment. The dark beds tend to be slightly enriched in several of the elements mentioned above as being enriched in Cretaceous black shales, particularly Cr, Cu, Ni, V, and Zn (Fig. 13), but these differences are not statistically significant and certainly are not so distinct as between the organic-carbon-rich and organic-carbon-poor Cretaceous strata (Fig. 7).

CONCLUSIONS

1. There has been little or no enrichment of elements from hydrothermal solutions in the red claystone overlying basalt basement at Site 530. Slight enrichments of

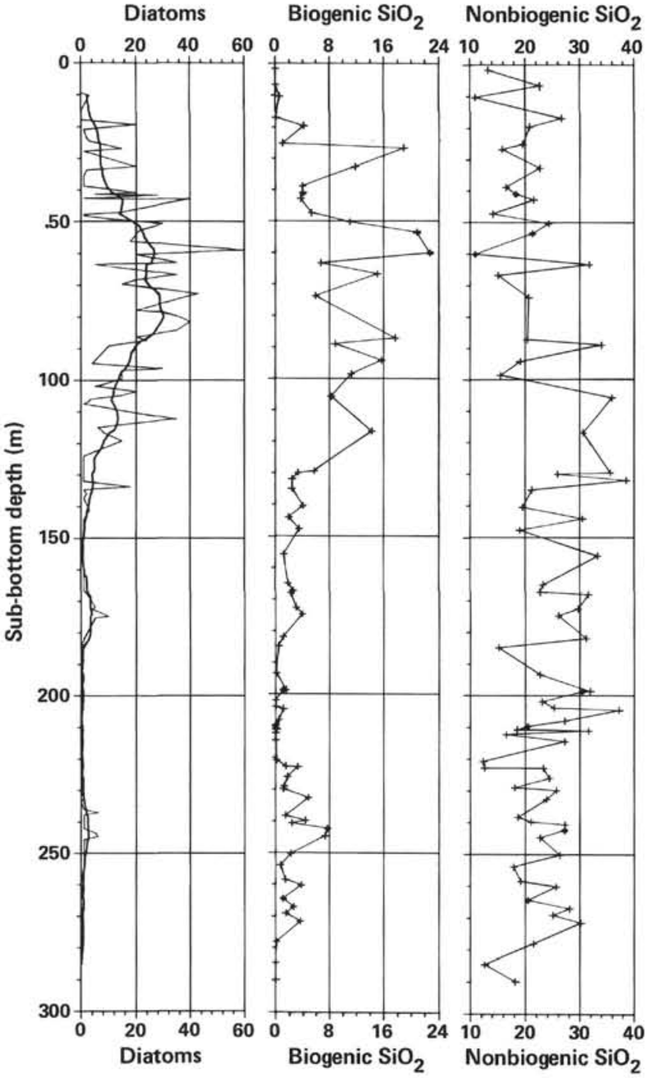


Figure 6. Plots of percent diatoms, percent biogenic SiO_2, and percent nonbiogenic SiO_2 in sediment from Holes 532 and 532B.

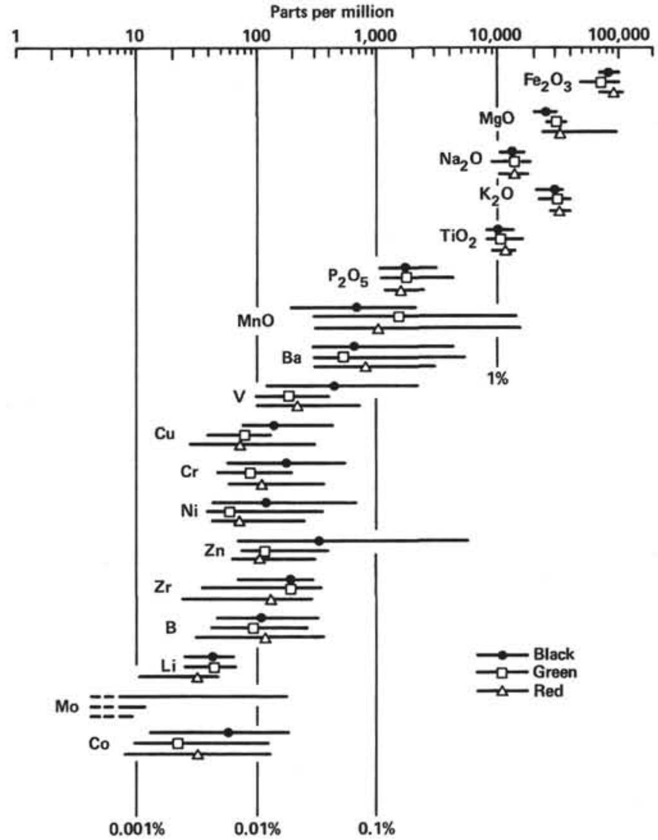


Figure 7. Comparison of element concentrations in 28 samples of black shale (dot), red claystone (triangle), and green claystone (square) from lithologic Unit 8, Hole 530A, Cores 87 through 105. Symbols are plotted at the geometric mean carbonate-free concentration for each element (Table 6). Bars indicate observed range of concentration for each element (Table 6). A dash at the lower end of a bar indicates that the lowest concentration of that element was below the detection limit of the instrumental method used.

several elements, particularly Fe and Mg in the first meter of sediment above basalt, may be the result of leaching of basalt by seawater.

2. Black-shale beds of Albian to Coniacian age at Site 530 are enriched in Cd, Co, Cr, Cu, Mo, V, and Zn relative to interbedded red and green claystones. These elements do not, however, all have maximum concentrations in the same black shale beds, but rather have different vertical concentration gradients within lithologic Unit 8, which suggests that certain elements were more mobile than others. These gradients further suggest that Co, Ni, and Pb were most mobile, and that Cd, Zn, Mo, and V were the least mobile during diagenesis of interbedded more-reduced and less-reduced sediments.

3. Volcanogenic sandstone turbidites of Campanian age at Site 530 contain particularly high concentrations of Al, Fe, Mg, Na, Ti, P, Co, Cu, Cr, Zr, and Sc.

4. Clay-rich, carbonate-poor sections of Late Cretaceous and Miocene age are enriched in Si, Al, K, B, Zr, Y, and La that probably are concentrated in clay minerals. Concentrations are high because the clay is not diluted by either siliceous or carbonate biogenic debris.

5. Upper Pliocene to lower Pleistocene sediments at both Sites 530 and 532 contain relatively high concentrations of biogenic silica (up to 20 wt.% and 30 wt.%, respectively) that accumulated during the period of maximum upwelling and diatom productivity of the Benguela-Current upwelling system.

6. The Plio-Pleistocene sediments at Sites 530 and 532 are essentially a three-component system of biogenic silica, biogenic calcite, and nonbiogenic material (mostly clay). Most major and trace elements reside in the nonbiogenic fraction. Only Sr is associated with the carbonate fraction, and only Ba and Mo are associated with the siliceous biogenic fraction.

7. The distinct dark-and-light color cycles that persist throughout the Miocene to Holocene section at Site 532 are essentially cycles of carbonate dilution by detrital clastic material and (or) biogenic silica. The dark parts of the cycles tend to be enriched in organic carbon, but there are no distinct enrichments of trace elements in the dark beds comparable to the differences observed between organic-carbon-rich and organic-carbon-poor Cretaceous strata at Site 530 and elsewhere.

Table 6. Summary statistics for concentrations of major element oxides and trace elements on a carbonate-free basis in samples of black shale, and green and red claystone from lithologic Unit 8, Hole 530A.

	Black					Green					Red				
Component	Min.	Max.	GM	GD	N	Min.	Max.	GM	GD	N	Min.	Max.	GM	GD	N
Oxide (%)															
SiO_2	38.8	70.2	56.7	1.148	28	56.9	72.2	63.5	1.075	27	43.3	67.5	58.2	1.127	12
Al_2O_3	9.5	14.6	11.8	1.107	28	9.5	14.8	12.1	1.143	27	10.5	14.1	12.6	1.134	12
Fe_2O_3	6.6	12.0	8.5	1.164	28	5.0	12.2	7.7	1.235	27	7.9	12.2	10.0	1.144	12
MgO	2.2	3.3	2.8	1.118	28	2.7	3.6	3.1	1.084	27	2.5	11.1	3.3	1.488	12
Na_2O	1.11	1.73	1.39	1.115	28	0.92	1.75	1.41	1.166	27	1.13	1.81	1.46	1.173	12
K_2O	2.25	3.38	3.17	1.117	28	2.35	4.19	3.21	1.144	27	2.89	4.02	3.43	1.139	12
TiO_2	0.81	1.41	1.11	1.139	28	0.71	1.61	1.15	1.228	27	0.94	1.48	1.23	1.178	12
P_2O_5	0.12	0.33	0.18	1.330	28	0.11	0.45	0.18	1.354	27	0.13	0.25	0.17	1.223	12
MnO	0.02	0.23	0.07	1.909	28	0.03	1.58	0.16	3.010	27	0.03	1.60	0.11	3.101	12
Element (ppm)															
As	<20	92	—	—	19	<20	61	—	—	6	<20	91	—	—	2
B	44	330	110	1.813	28	40	260	93	1.669	27	30	340	130	2.170	12
Ba	270	440	660	2.582	28	300	5400	530	2.100	27	300	3200	830	2.336	12
Be	<3	4.0	—	—	10	<3	3.3	—	—	5	<3	3.0	—	—	2
Cd	<6	114	—	—	17	<6	77	—	—	10	<6	54	—	—	8
Co	13	180	59	2.066	28	9.2	150	23	1.800	27	7.5	150	33	2.600	11
Cr	57	570	180	1.989	28	48	190	90	1.453	27	58	380	112	1.805	12
Cu	75	430	150	1.639	28	38	144	82	1.972	27	29	310	73	2.064	12
Ga	<20	170	—	—	15	<20	190	—	—	12	<40	120	—	—	7
Li	25	63	42	1.313	28	25	67	44	1.294	27	10	48	31	1.560	12
Mo	<5	190	—	—	16	<5	12	—	—	12	<7	9.1	—	—	4
Ni	40	660	130	2.245	28	37	340	62	1.616	27	41	260	77	1.800	12
Pb	<20	100	—	—	10	<20	130	—	—	6	<20	71	—	—	2
Sc	10	39	21	1.338	28	14	55	23	1.331	27	7	37	21	1.560	12
Th	<10	140	—	—	12	<10	81	—	—	15	<10	71	—	—	6
V	120	2200	460	2.418	28	97	400	190	1.483	27	99	750	210	1.863	12
Zn	68	5900	320	3.452	28	73	380	120	1.532	27	63	300	110	1.657	12
Zr	61	290	170	1.441	28	34	340	170	1.572	27	21	280	140	2.313	11
Y	21	70	33	1.429	28	16	57	31	1.405	27	10	39	29	1.449	12
La	8.2	65	32	1.471	28	19	77	36	1.354	27	6.1	57	30	1.802	12
Ce	44	250	83	1.590	26	30	270	86	1.658	26	41	210	79	1.721	11
Yb	2	11	5.5	1.584	25	2	7.7	3.9	1.520	24	2	8.1	4.6	1.533	10

Note: The minimum and maximum observed concentrations are given as Min. and Max., respectively. The geometric mean and geometric deviation are given as GM and GD, respectively. N is the total number of samples that contained measurable concentrations greater than the lower detection limit for that element or oxide. Dashes under columns for GM and GD indicate that GM and GD were not calculated because some samples were below the detection limit for that element (indicated by less-than, <, symbol in Min. column).

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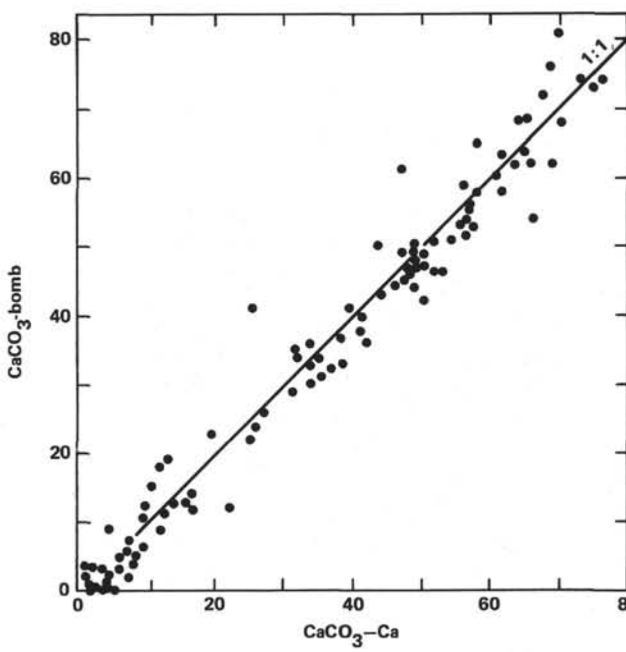

Figure 8. Scatter plot of percent $CaCO_3$ determined by shipboard carbonate-bomb and calculated from analyses of total Ca in 121 samples from Holes 530A, 530B, 532, and 532B.

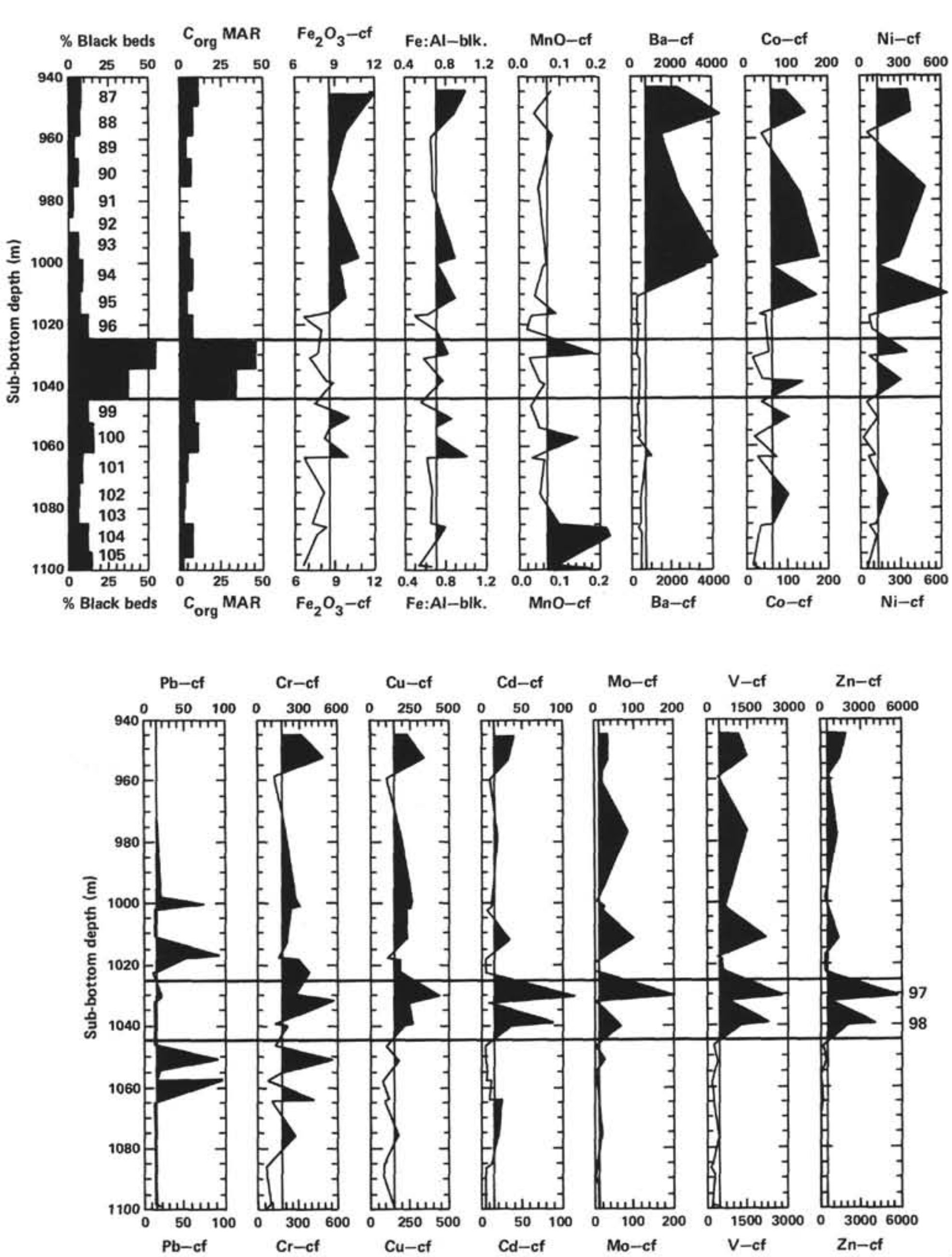

Figure 9. Plots of carbonate-free (cf) concentrations versus depth for Fe_2O_3, MnO, Ba, Co, Ni, Pb, Cr, Cu, Cd, Mo, V, and Zn in samples of black shale from DSDP Hole 530A, southern Angola basin. Concentrations of Fe_2O_3 and MnO are in percent; all other concentrations are in parts per million. The Fe:Al ratio in black-shale samples, the percentage of black-shale beds in each 9.5-m cored interval, and the mass accumulation rate (MAR; $g/cm^2/m.y.$) of organic carbon for each 9.5-m cored interval also are plotted. The vertical line through each concentration plot is at the geometric-mean concentration for that element or oxide. All values greater than the geometric mean are shaded. The numbers (87 through 105) within the plot for percentage of black-shale beds are the numbers of each core. The two horizontal lines drawn through all plots are drawn at the top of Core 97 and the bottom of Core 98 and mark the zone of maximum black-shale-bed concentration.

Table 7. Summary statistics for concentrations of major-element oxides and trace elements on a carbonate-free basis in samples of red claystone above basalt basement in Hole 530A.

Component	Min.	Max.	GM	GD
Oxide (%)				
SiO_2	40.5	65.5	60.0	1.145
Al_2O_3	7.3	12.9	10.9	1.167
Fe_2O_3	5.6	12.0	9.2	1.238
MgO	2.3	4.1	3.4	1.159
CaO	0.57	20.5	1.36	2.690
Na_2O	0.74	1.43	1.16	1.182
K_2O	2.09	3.74	3.31	1.184
TiO_2	0.58	1.11	0.94	1.190
P_2O_5	0.11	0.21	0.19	1.209
MnO	0.05	1.29	0.12	2.439
Element (ppm)				
B	50	190	75	1.464
Ba	240	470	350	1.182
Cd	3.5	94	11	3.187
Co	11	42	24	1.463
Cr	37	210	76	1.657
Cu	42	210	72	1.561
Ga	14	90	37	1.828
Li	27	60	41	1.295
Ni	47	97	74	1.211
Pb	14	20	15	1.114
Sc	15	27	21	1.186
Sr	130	380	160	1.347
Th	7	30	9	1.554
U	70	200	77	1.372
V	75	300	140	1.574
Zn	49	140	97	1.332
Zr	20	290	150	2.110
Y	24	37	31	1.154
La	12	55	33	1.471
Ce	21	180	90	1.755
Nd	35	90	43	1.450
Dy	4	25	10	2.153
Yb	3	6	4	1.307

Note: The minimum and maximum observed concentrations are given as Min. and Max., respectively. the geometric mean and geometric deviation are given as GM and GD, respectively.

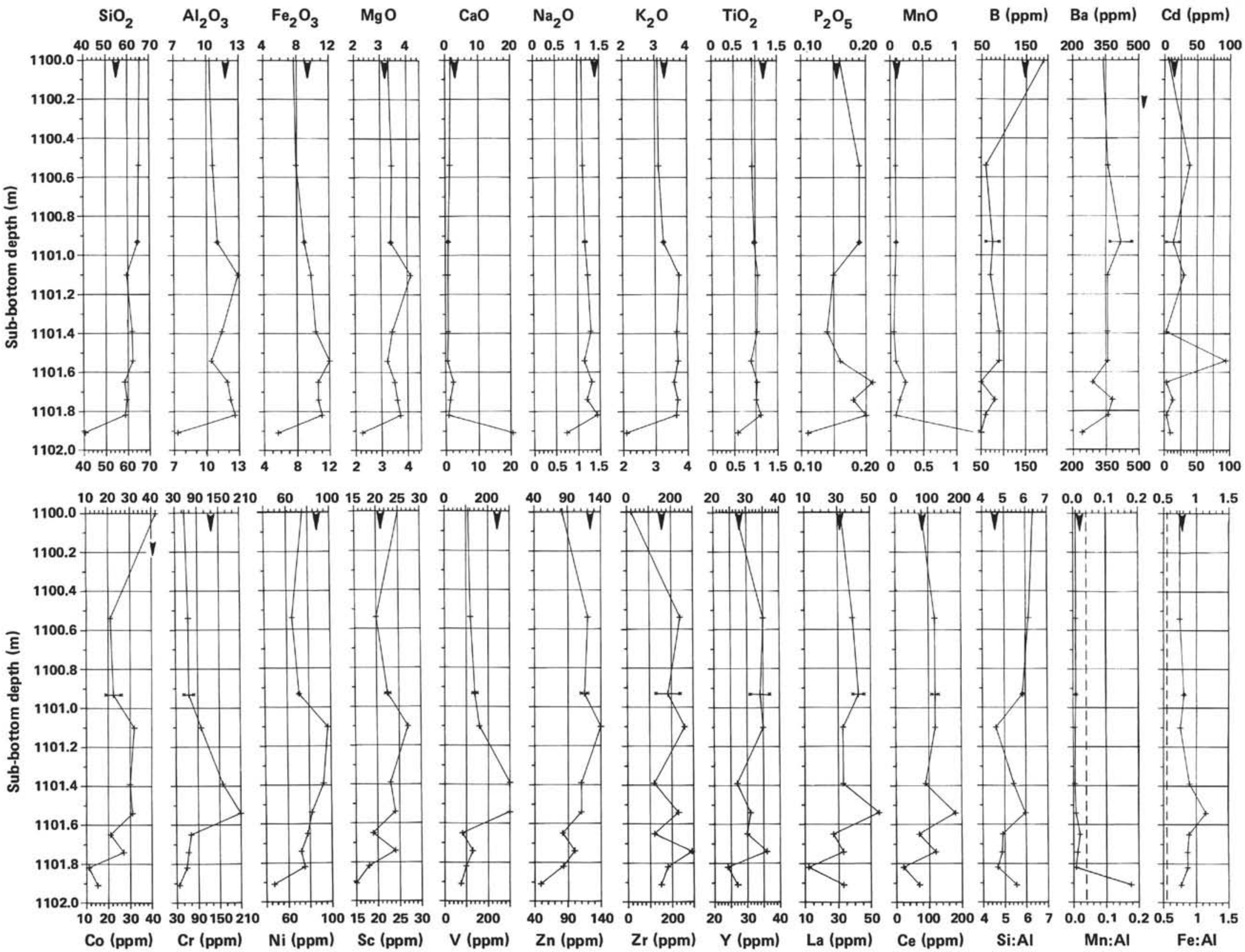

Figure 10. Plots of concentrations of major-element oxides (in percent, carbonate-free), trace elements (in parts per million, carbonate-free), and the ratios Si:Al, Mn:Al, and Fe:Al in samples of red claystone immediately above basalt basement in Hole 530A. The ar row on each plot indicates the average concentration of that element or oxide in red claystone in Cores 87 through 105 (Table 6). Dashed lines on plots of the ratios Mn:Al and Fe:Al represent values of these ratios in average Pacific pelagic clay.

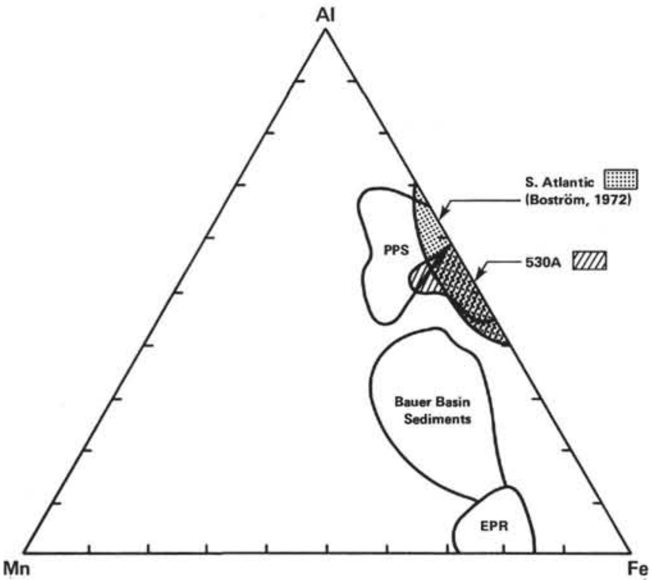

Figure 11. Triangular diagram showing relative concentrations of Al, Mn, and Fe in samples taken above basalt basement in Hole 530A. Areas representing ranges in concentrations of Al, Mn, and Fe in sediments from the Bauer Deep, East Pacific Rise (EPR), and Pacific pelagic sediments (PPS) are from Bischoff and Rosenbauer (1977). Ranges representing surface pelagic sediments from the South Atlantic are from Boström et al. (1972).

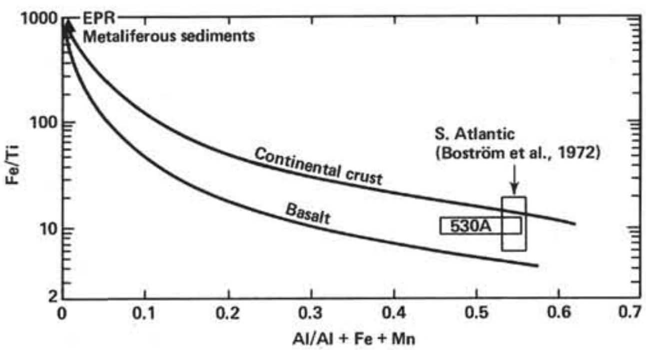

Figure 12. Plot of Fe/Ti and Al/Al + Fe + Mn ratios for samples taken above basalt basement in Hole 530A. Curves represent mixing of average oceanic basalt material and average continental crustal material with metalliferous sediment from the East Pacific Rise (EPR). Modified from Boström (1970). Ranges of values from surface pelagic sediments from the South Atlantic are from Boström et al. (1972).

Table 8. Summary statistics for concentrations of major-element oxides and trace elements on a carbonate-free basis in samples of dark and light sediment from dark-light color cycles in Holes 532 and 532B.

	Dark					Light				
Component	Min.	Max.	GM	GD	N	Min.	Max.	GM	GD	N
Oxide (%)										
SiO_2	36.3	59.7	50.0	1.098	27	42.8	66.2	53.4	1.097	32
Al_2O_3	9.1	15.5	13.4	1.154	27	6.5	16.4	12.9	1.263	32
Fe_2O_3	4.7	8.2	6.8	1.173	27	3.3	8.5	6.3	1.269	32
MgO	2.4	3.9	3.1	1.111	27	2.1	10.8	3.8	1.408	32
Na_2O	2.2	5.1	2.9	1.202	27	2.1	4.1	2.9	1.173	32
K_2O	1.5	3.0	2.3	1.233	27	0.4	3.2	1.7	1.496	32
TiO_2	0.45	0.88	0.65	1.193	27	0.27	1.52	0.57	1.351	32
P_2O_5	0.13	0.31	0.21	1.261	27	0.13	0.42	0.24	1.335	32
Element (ppm)										
B	110	350	190	1.321	27	99	380	210	1.444	32
Ba	690	2400	1200	1.282	27	560	2800	1400	1.385	32
Co	<8	25	15	1.399	20	<10	47	17	1.444	20
Cr	120	280	210	1.251	27	82	280	170	1.342	32
Cu	49	150	94	1.310	27	36	130	73	1.381	32
Li	45	120	82	1.272	27	40	130	85	1.312	32
Mo	<10	86	26	1.841	24	<11	71	26	1.544	21
Ni	67	170	110	1.224	27	44	150	91	1.319	32
Sc	<11	46	22	1.455	25	15	57	23	1.397	32
V	86	190	130	1.242	27	63	240	124	1.304	32
Zn	110	230	160	1.225	27	77	310	140	1.395	32
Zr	<31	480	110	1.838	23	<18	220	92	1.040	23
Y	<14	60	32	1.410	26	12	66	30	1.399	32
La	<10	55	27	1.634	22	<12	130	34	1.680	25
% $CaCO_3$	13	65	34	1.526	27	28	76	54	1.226	32
Si:Al	3.16	6.59	3.72	1.196	27	3.15	10.24	4.16	1.351	32

Note: The minimum and maximum observed concentrations are given as Min. and Max., respectively. The geometric mean and geometric deviation are given as GM and GD, respectively. N is the total number of samples that contained measurable concentrations greater than the lower detection limit for that element or oxide.

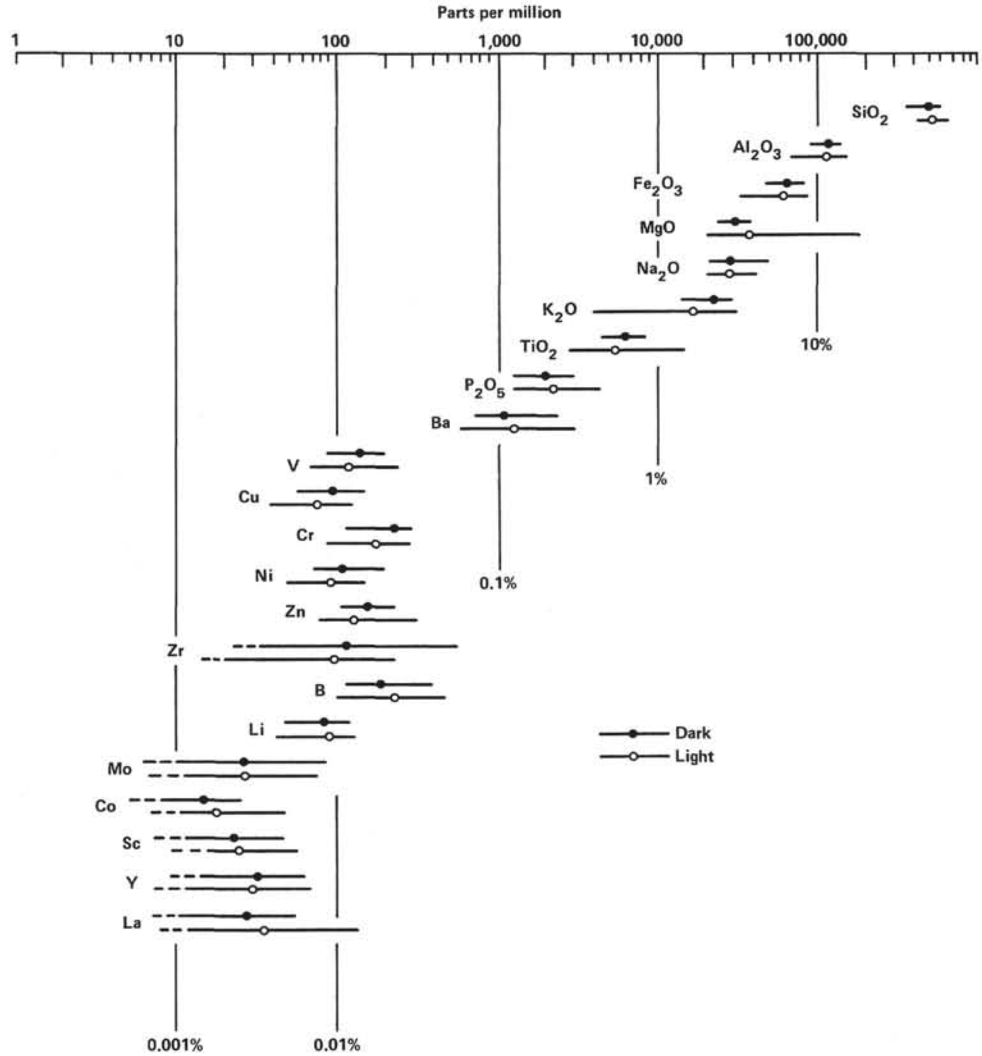

Figure 13. Comparison of element concentrations in 32 samples of light-colored sediment (open dots) and 27 samples of dark-colored sediment (solid dots) from dark-light color cycles in Holes 532 and 532B. Symbols are plotted on the geometric mean concentration, on a carbonate-free basis, for each element (Table 8). Bars indicate observed ranges of element concentrations (Table 8). A dash at the lower end of a bar indicates that the lowest concentration of the element was below the lower detection limit of the instrumental method used.